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ABSTRACT: This study was designed to determine if the implementation of satellite outpatient pharmacies at Wilford Hall USAF Medical Center significantly reduced the patient wait time at the main outpatient pharmacy. Satellite pharmacies have been placed in the Pediatric and Primary Care waiting areas and are designed to provide for initial fill prescriptions only. Data was gathered regarding patient wait times prior to the satellite's implementation and again afterwards. Statistical analysis of the data revealed that there was a significant decrease in patient wait time between the two studies. Although the implementation of the satellite pharmacies can not alone be credited for the change, it is felt, given all factors, that it was the singularly most significant change. The resulting change has resulted in an average patient wait time of less than fifteen minutes.

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A STUDY TO DETERMINE
PATIENT WAITING TIME AT THE
OUTPATIENT PHARMACY
AT WILFORD HALL USAF MEDICAL CENTER

A Graduate Research Project
Submitted to the Faculty
of Baylor University
in Partial Fulfillment of the
Requirements for the Degree
of
Master of Health Administration
by
Captain Craig A. Cyr, USAF, MSC
June 1988

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Chapter 1

Introduction

Facility Background

Wilford Hall USAF Medical Center (WHMC) is a 1,000-bed medical center located at Lackland Air Force Base, San Antonio, Texas. It is the largest medical treatment facility in the United States Air Force Medical Service and is its premier medical treatment, education and clinical investigation center (United States, WHMC 1). Services offered include over 100 medical and surgical specialties and sub-specialties, a Level I Trauma Center, a Neonatal Intensive Care Unit, a Department of Defense (DOD) (one-of-a-kind) Bone Marrow Transplant Center, a Renal Transplant Program, numerous clinical research projects and a multitude of other services and programs.

The physical plant encompasses one main building and numerous outlying dispensaries, dental clinics, pharmacies, and support operations. The hospital itself totals over 1.2 million square feet with over 400,000 square feet in the other facilities. Of significant interest is that the building encompasses over 12 miles of hallways.

The number and complexity of manpower required to operate a facility of this size is significant. With emphasis on research, graduate medical education, medical technician training and the fact that WHMC is the tertiary care facility for the Air Force,

numerous personnel are required. In total, this equates to over 4,000 officers, enlisted personnel and civilians. In addition, aggressively managed volunteer and Red Cross programs provide an average of 405 volunteers per month for an estimated manpower savings of over \$100,000 (United States, Cmdrs 7).

Wilford Hall Medical Center workload statistics for fiscal year 1987 begin to provide an appreciation for the difficulties encountered in the day-to-day provision of services to the beneficiary population (United States, Cmdrs 28). The average daily patient census runs approximately 680 with nearly 2,000 patients admitted each month. The outpatient clinics average over 76,000 visits per month or more than 3,500 per duty day. These patient loads equate to over 2,000,000 prescriptions filled, more than 534,000 x-ray films exposed and an excess of 7,000,000 lab test being accomplished each year.

Problem Introduction

Given the complexities of a facility the size of WHMC, the magnitude of workload, the continuous turnover of personnel and numerous other factors, patient sensitivity becomes a significant issue. Over a period of time, it appeared that numerous complaints were being received from patients who felt that wait times at the outpatient pharmacy were excessive. It was this concern that motivated the Medical Center Administrator to request that patient waiting times at the outpatient pharmacy be studied. It was at this time that an average of 15 minutes would

be considered an acceptable standard of wait for patient presenting to the outpatient pharmacy. Therefore, the purpose of this study is to provide the administrator and the executive staff as accurate a picture as possible as to the actual patient experience at the outpatient pharmacy.

Pharmacy Services

Before looking at the specifics of the outpatient pharmacy study, a brief introduction to pharmacy operations at WHMC will be presented. Pharmacy services are diverse in both what is offered and location. The main inpatient pharmacy is located in the basement of the main building and serves the needs of both ambulatory and nonambulatory inpatients as well as providing courtesy service to Wilford Hall staff. Several specialty pharmacies exist throughout the facility to include the DOD Bone Marrow Transplant Center pharmacy. Outpatient services are provided by pharmacies located in three separate buildings. The main outpatient pharmacy is located in the medical center and provides for initial prescription filling only. Adjacent to the outpatient clinics parking lot is a satellite pharmacy that provides for refills only. To provide pharmacy service for Air Force Trainees undergoing basic military training at Lackland Air Force Base, there is an outpatient pharmacy within the base dispensary on the training side of the installation. As of January 1988, modular, satellite pharmacies have been placed in the Primary Care and Pediatric Clinics. These are designed to

provide pharmacy services to their particular clinics but are open to anyone who presents with a new (not refill) prescription.

Staffing for the pharmacies within the Medical Center is made up of licensed pharmacists, military and civilian, and pharmacy technicians trained by the Air Force. These technicians are permitted to accomplish nearly everything a licensed pharmacist can do. A short discussion of the role of the pharmacy technician is presented within the literature review of this paper. Suffice it to say at this point that the military provides these individuals greater latitude and responsibility than their civilian counterparts.

Given that the intent of this paper is to provide input to executive management regarding outpatient pharmacy waiting times, the study has been limited to the main outpatient pharmacy and the two satellite pharmacies. For the purposes of this paper, the initial fill pharmacy located in the main building will be termed "main" and the modular, satellite pharmacies located in the Pediatric and Primary Care Clinics will be termed "satellites".

The main pharmacy is located on the first floor of the clinic wing of the Medical Center (see figure 1). It is centrally located in relation to most of the clinics and provides the majority of outpatient pharmacy services for the beneficiary population. The physical layout consists of a 575-square-foot patient waiting area and a 767 square foot pharmacy as shown in figure 2.

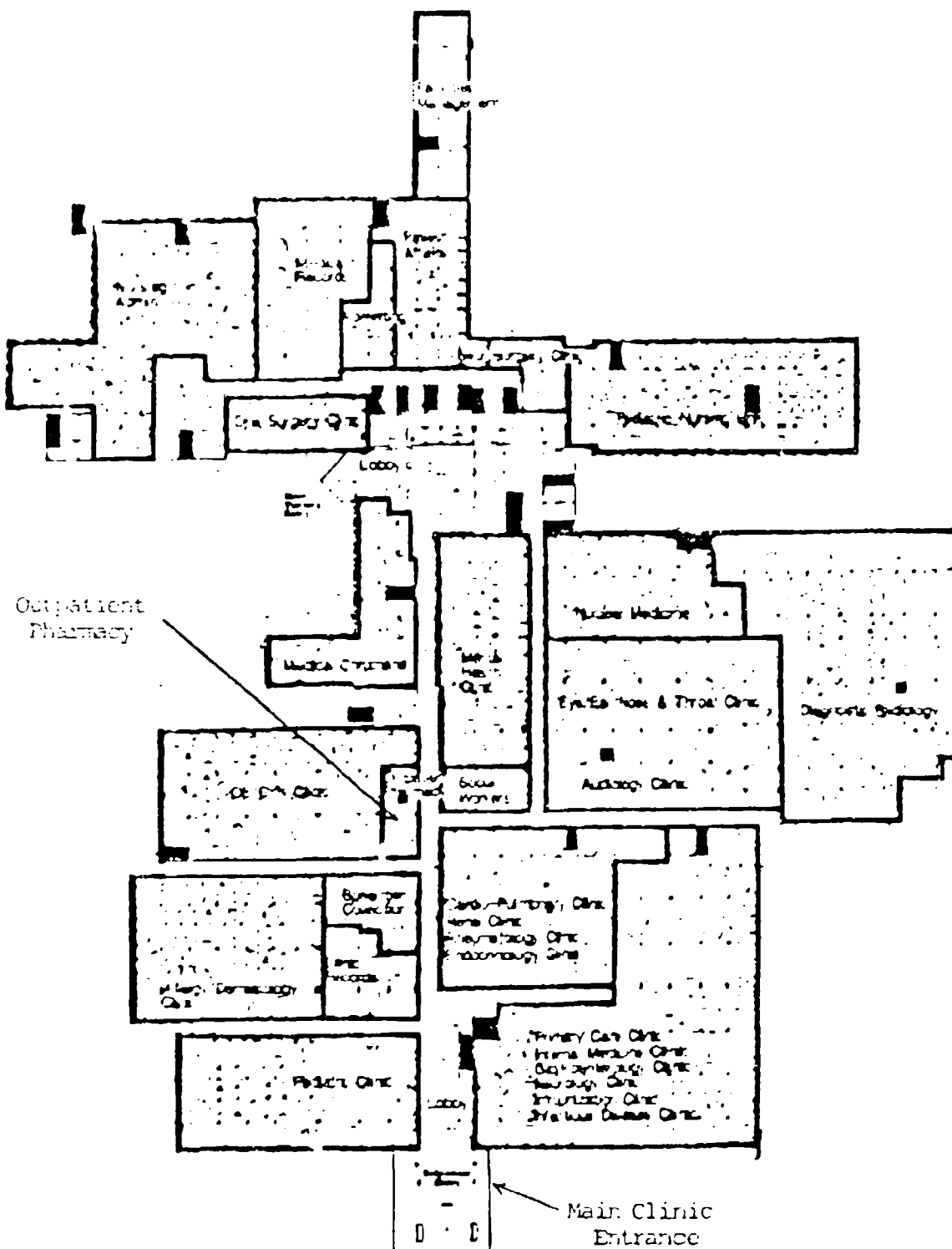


Fig. 1 Wilford Hall USAF Medical Center, First Floor

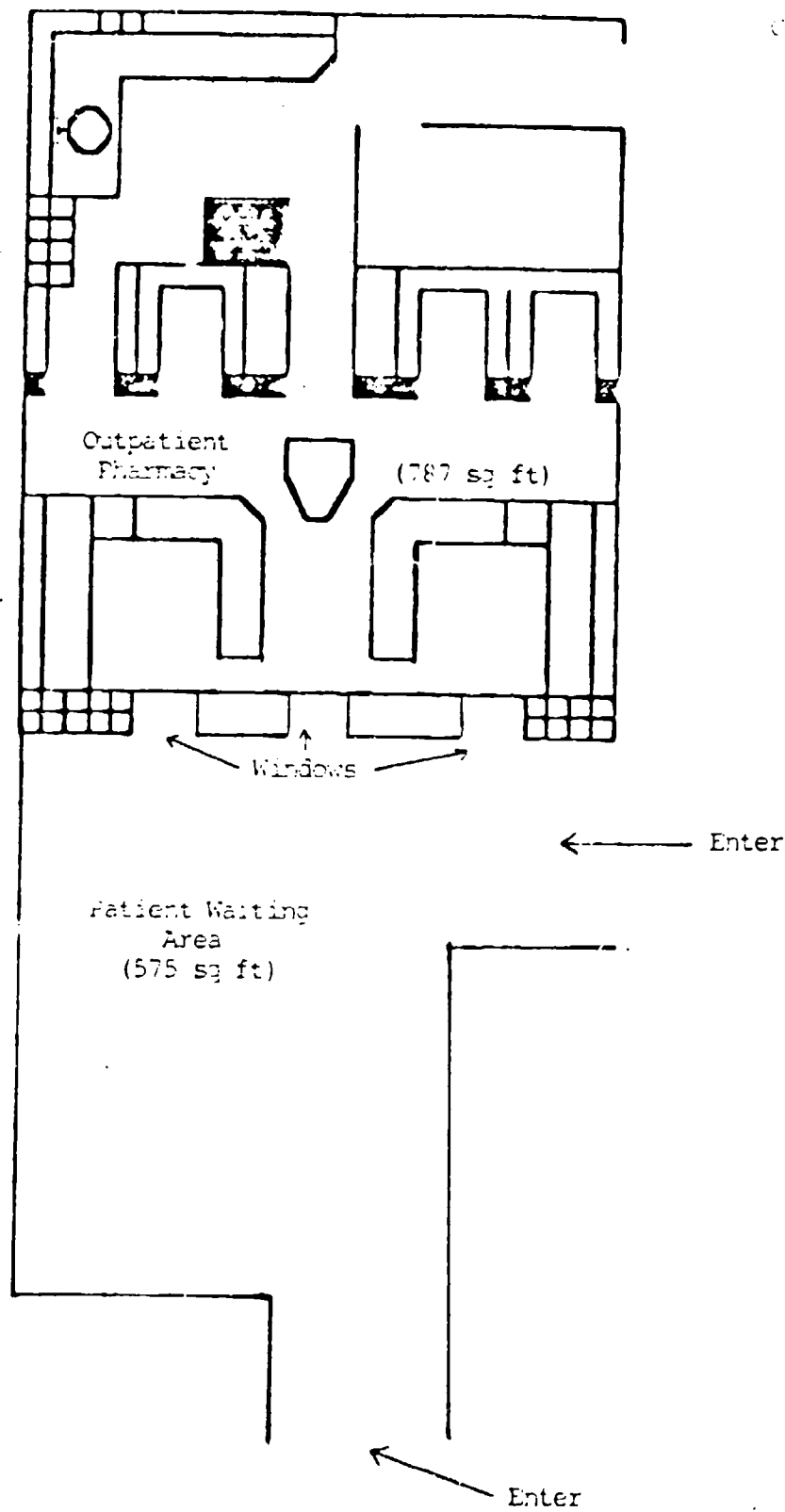
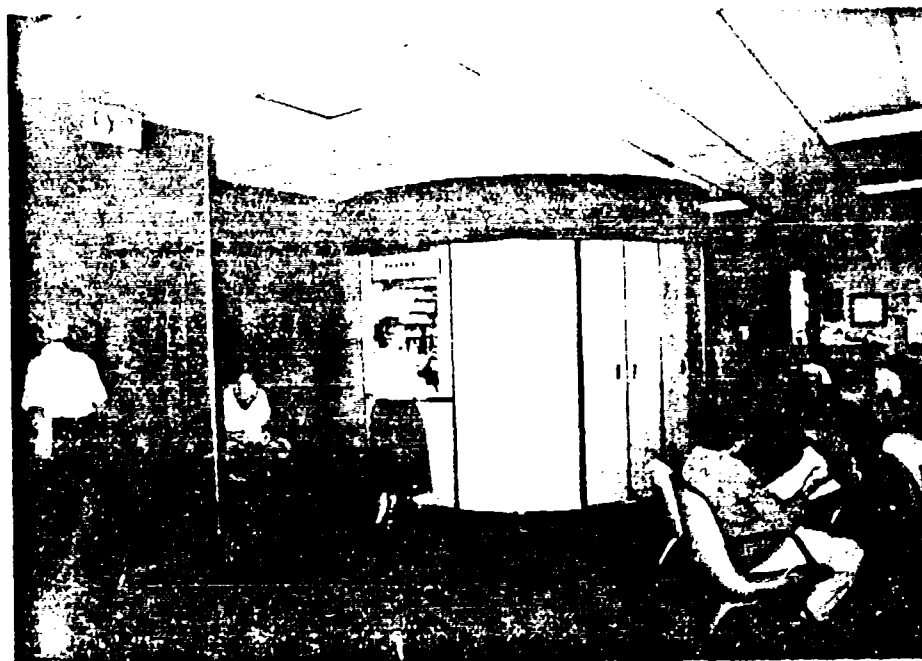


Fig. 2 Outpatient Pharmacy and Waiting Area Layout

In January of 1965 two satellite pharmacies were purchased and installed. These were placed in the Pediatric and Primary Care Clinics so as to help alleviate congestion in the main pharmacy and to provide faster and more convenient service to patients. Each of these is a freestanding, independent pharmacy as shown in figure 3. Occupying only 110-square-feet of floor space and requiring only electrical and water connections, they present no significant loss of space or traffic flow problems in their respective waiting areas. They are equipped with space for a narcotics locker, refrigerator and sink along with 168 square feet of bulk storage shelving. As such they can provide for nearly all pharmaceutical requirements presented at either location.

Research Question

Given the Administrator's concern expressed above, the following statement was used to direct this study: To determine the effects of instituting satellite pharmacies on waiting times at the main outpatient pharmacy at Wilford Hall USAF Medical Center.



Satellite Pharmacy - Primary Care Clinic



Satellite Pharmacy - Interior

Chapter II

Survey Development and Administration

Study Procedure

As stated above, the intent of this study is to provide executive management and the pharmacy service with data to validate whether the implementation of the satellite pharmacies in the Pediatric and Primary Care Clinics had a significant impact on patient waiting times in the main pharmacy. As an additional benefit, the data collected will provide Pharmacy management information regarding actual waiting times, figures that have not been available for quite some time. To accomplish the study, a two-phase approach was taken.

The initial data gathering was accomplished in late November and early December of 1987. This established a base line patient waiting time for the main pharmacy prior to the installation of the satellite pharmacies.

Given sufficient time for personnel to become familiar with the new facilities and procedures and for the patient population to become familiar with the new service, data was again gathered in March of 1988 to provide information regarding any significant changes.

In order to establish the waiting time for patients presenting to the main, data was collected on three separate days before and after the implementation. This data was taken between the hours of 7:30 AM and 4:30 PM (typical clinic hours for WHMC). The following provides a description of the procedures used in this study.

The WHMC main pharmacy operates an extremely busy, personnel intensive service with some 2,000 drugs in its formulary. In order to accommodate the massive workload, numerous initiatives have been taken in the last two years to maximize space and efficiency. One of the more significant approaches was the institution of a "Dual Track" system in which two separate but interrelated service lines can be operated at any given time. The intent was to provide faster service to patients while minimizing traffic problems within the pharmacy. Figure 4 depicts the layout of the pharmacy and how the "Dual Track" operates. The dual track system allows for filling prescriptions which the patient is going to wait for (usually in the waiting area) and for "Drop-offs".

The drop-off system utilizes the middle or number two window to accept prescriptions for which patients are willing to wait a minimum of three hours before pick-up. This system is designed for those patients who have the flexibility to come back later in the day or even within the next two days.

Sides one and two operate identically by:

- * Receiving prescriptions at windows #1 and #2 ("A").
- * Inputting the prescriptions to the computer system at "B".
- * Filling prescriptions at "C".
- * Checking and labeling (by pharmacists) at "D".
- * Dispensing at common window (#3) by volunteers ("E").

T=Terminals
P=Printers

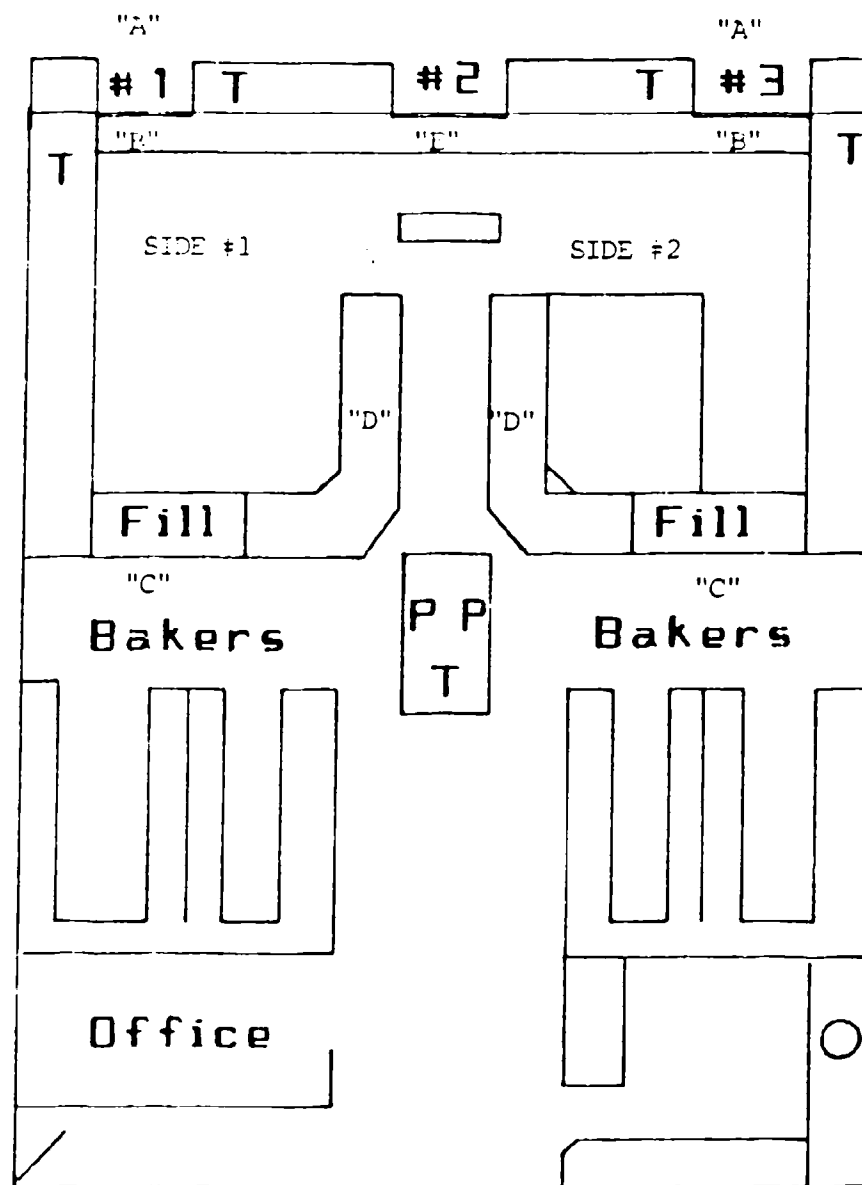


Fig. 4 "Dual-Track" System

For the purpose of this study, only the patients deciding to wait for their prescriptions were studied. This decision was based on the fact that patients who accept a minimum of a three-hour wait have voluntarily accepted their wait time. The study was also restricted to one side of the dual track system in that the secondary track provides a backup to the primary track and is complicated by the fact that it fills the "drop-off" prescriptions as well as routine.

The procedure currently used at the main pharmacy results in the patient's wait being divided into two parts. This is due to the use of a rotary number dispenser from which patients must take a number in order to be called to turn in their prescriptions. This eliminates the patients from ever having to stand in a line and also provides the perception of having a shorter waiting time as the total wait is divided into two separate time frames. The following provides a typical description of the procedure a patient encounters at the Outpatient Pharmacy.

As the patient presents to the pharmacy with their prescription they must read the signage which explains the procedures to be followed and options available (see figure 5). (General observation suggests that the majority of individuals unfamiliar with the system fail to read and present directly to the window. Suggestions for resolving some of this confusion are presented later in the paper.) The patient then decides whether to take a number and wait or to use the three-hour drop off system.

Figure 1. Increase in salivary amylase activity at the City of Dent Pharmacy.

If the patient decides to take a number, they pull a number and take a seat. After a period of time their number is called and they are directed to either window number one or three. At the window their prescription is taken and checked for errors or illegibility. For the purpose of this study, this aspect of the wait will be termed external wait. The patient is instructed to take a seat and wait for their name to be called. This aspect of the wait will be termed the internal wait.

The internal wait is comprised of the time it takes the pharmacy to actually fill the prescription. This involves inputting the prescription into the computer (updates the patient data base, looks for drugs interactions, produces prescription labels, etc.), filling the prescription, checking it for correctness and calling the patient for pick-up.

In order to determine the average time patients waited for their prescriptions, the following procedure was used:

External wait - Periodically (not less than four times per hour) the researcher removed a number from the rotary number dispenser and annotated the time. As soon as that number was called, the time was again annotated. The difference between the two times provides a sample of the time it takes for a patient's number to be called after arriving at the pharmacy.

Internal wait - To determine the time required to actually fill the prescription and get it to the patient, time stamp clocks were used. The pharmacy technician at the window would, upon receipt of the prescription, time stamp it prior to inputting the patient information into the computer terminal.

The prescription is then handed to another technician who is responsible for filling it. After the prescription is filled it is checked by a pharmacist and the drugs and prescription are placed on a counter. At this time the patient's name is called, typically by a WHMC volunteer, to pick up their prescription. To determine the internal wait time the researcher annotated the time as soon as the patients name was called. The difference between the two times provides the time taken within the pharmacy. It should be noted that the clock stopped when the patients name was called, not when the patients actually received the drugs. For the purpose of the study it was decided that patients who did not wait for their prescriptions in the waiting area had voluntarily accepted a greater wait time and were beyond the control of pharmacy personnel. Prescriptions to be timed were selected randomly regardless of the number of items on the prescription.

Assumptions

Several assumptions have been made for the purpose of this study. They have been researched to the best of the researcher's ability, however, they are beyond verification. The most significant of these is that the beneficiary population has remained constant. Given that there are several military health treatment facilities in the San Antonio area, a change in service at one could well affect the others. No such change has been noted. Another assumption is that medical practice patterns did

not change appreciably during the course of the study. WHMC did not bring on new services nor delete any services that would affect the outpatient pharmacy's workload. Nor was there a change in the philosophy of the quality or quantity of care provided. The final assumption is that staffing patterns for the outpatient pharmacy remained the same throughout the study and therefore any change in patient wait times would not be attributable to an increase or decrease in pharmacy personnel.

Given the above assumptions, it is felt that the only appreciable change that took place in the time between the two data gathering dates was the installation of the two satellite pharmacies. As noted elsewhere in this paper, there was a change in policy to restrict the issuance of bulk laxatives. However, it is felt by pharmacy management that this had little to no impact on patient wait times. In fact, if any impact would have resulted, it would be in favor of a longer wait as these prescriptions can be filled quite rapidly.

Study Problems

Given the the complexities found in WHMC's ambulatory care setting which provides nearly one million outpatient visits per year, numerous factors influence the operation of outpatient pharmacy services. Many of these either directly or indirectly influence patient waiting times. The following discussion will present several of these factors and their potential for impact on the study.

Due to the number of clinics in operation and the vast number of patients seen each day, it is impossible to assume that the arrival of patients to the main pharmacy ever reaches a steady state. Clinic workload varies daily due to particular providers schedules, specialty clinics and various nonroutine activities. Appendices A through F reflect the variations in arrival rates throughout the day for the days studied. Due to these variations, the validity of using Queuing Theory becomes questionable (Levin 66B). It is for this reason that this methodology was not used.

Certain factors may significantly influence waiting times for particular patients. One is the number of drugs prescribed for a particular individual. A random sample of 100 prescriptions (appendix G) reflected that the average number of prescriptions was 2.13 per patient, however, it was not uncommon to see patients receiving up to eight items. Another example would be those patients presenting with prescriptions for controlled substances. The procedures required to maintain security of these items necessitates additional time.

Federal budget constraints in fiscal year 1988 have brought about a significant number of management decisions designed to cut costs. Within WHMC, pharmacy services were no exception. Between the time the initial and final data gathering was accomplished, several items were removed from the formulary or restricted to certain providers or category of beneficiary. The most significant, in terms of numbers of prescriptions, was bulk laxatives. With the discontinuance of the dispensing of bulk

laxatives, the patient wait time could be affected. This is due to the fact that the filling of this prescription is quite simple and fast. Taking this out of the equation might tend to cause overall wait times to increase. Therefore any improvement shown in this study may very well be understated. Given the limited time available to accomplish this study it is difficult to assume that the periods selected to gather data were representative of patient wait times to be experienced throughout the year. Given the very nature of health care facilities, there is significant variability in patient loads and the types of disorders treated at various times. This can be seen in a graphical representation of the WHMC pharmacy workload for October 1987 to March 1988 in figure 6.

Outpatient Pharmacy Workload Summary

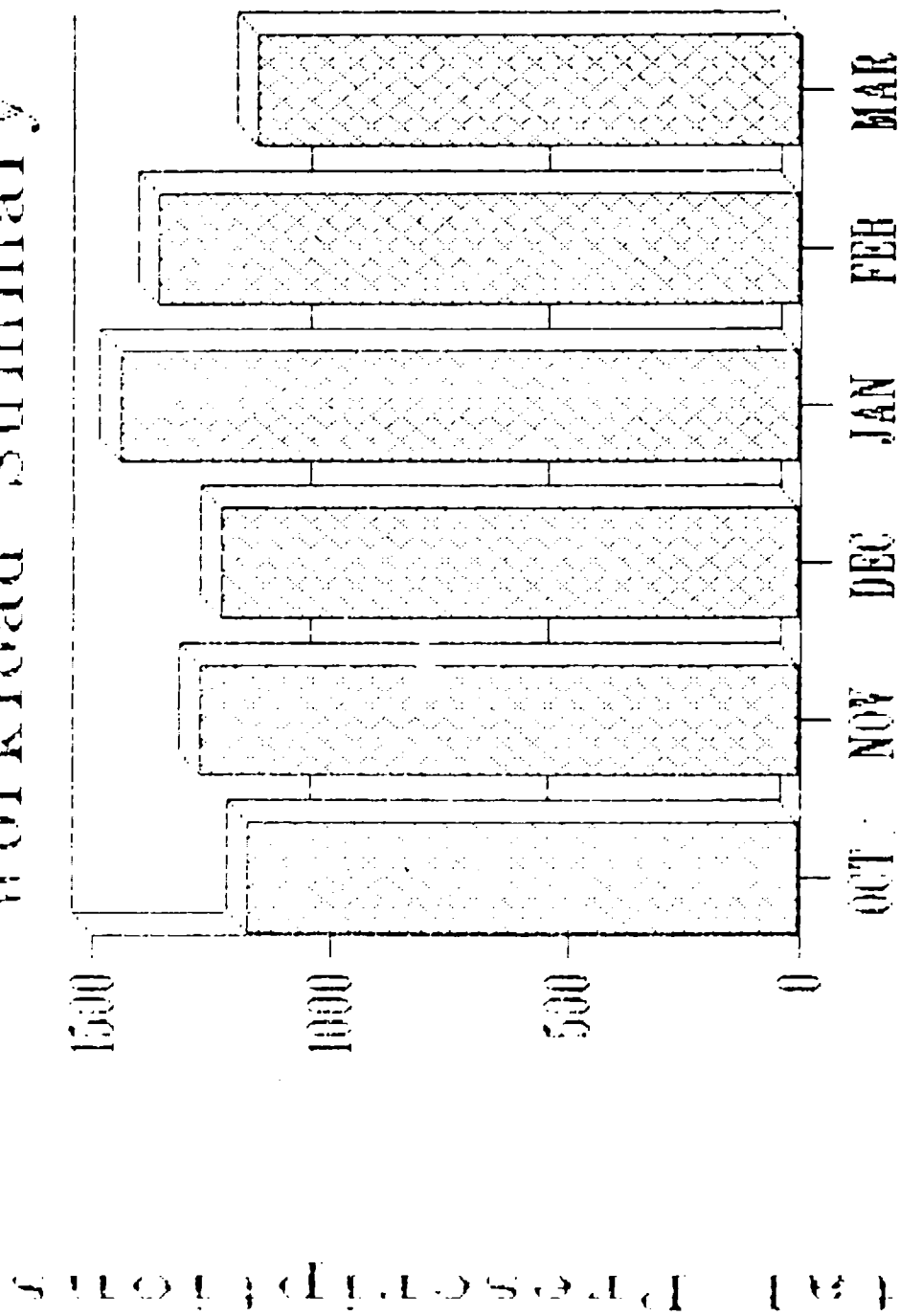


Fig. 6 Pharmacy Workload Summary

Oct 87 - Mar 88

Chapter III

Analysis and Discussion

Findings

The findings of this study can be divided into two aspects. The initial aspect is that which generated the study, patient satisfaction with the pharmacy services, specifically, patient waiting times. The other is the statistical verification as to whether the implementation of the two satellites did indeed improve (shorten) wait times at the main pharmacy.

Given that the main emphasis of the study was to be on the actual waiting times, the current WHMC outpatient questionnaire (appendix H) was used as the device to measure relative patient satisfaction before and after the satellites were opened. It is realized that this is not the ideal tool to measure patient satisfaction with patient waiting times. It is certainly nonspecific in regards to the different aspects of pharmacy service (see item 4c of appendix H), however, it is felt that wait times at the pharmacy are probably one of the most significant irritants to the user. Also, since there was no conscious effort to force the questionnaire on the entire user population, there may be a respondent bias in that many times it

is the dissatisfied individual who responds to these questionnaires and not those pleased with the services provided.

The WHMC Commander's Patient Representative office is responsible for the collection and interpretation of the outpatient questionnaires. The data contained on the questionnaires is input monthly into the WHMC mainframe computer against the SPSS[®] statistical software package. The resulting data (sample provided at appendix I) is used to track problems areas, note improvements, etc. It is this data that was used as a measure of change, if any, that would be found due in part to the satellite pharmacies.

The findings of patient satisfaction are based on 1,045 patient questionnaires received from July 1987 to April 1988. Data from January 1988 was omitted as this was the month that the satellites were installed and data from that month would not reflect an accurate picture of either the before or after situation. Unfortunately the amount of data available in both the before and after modes is less than would have been ideal. The questionnaire used was developed by Captain Thomas Fewell, the previous administrative resident from Trinity University and was not placed into use until July 1987. The constraints of the one-year residency and the implementation date of the satellites precludes data collection past April 1988. Additional data collection as the patient population becomes accustomed to the new satellites would reflect a more accurate picture of patient satisfaction as a result of their being placed in operation. The results of analysis of the outpatient questionnaires before

and after implementation of the satellite pharmacies reflect no significant difference. This is based on the findings shown in table 1 below. The means are derived from placing a value of 1 to 4 on the level of patient satisfaction (rated from poor to excellent).

Table 1

WHMC Outpatient Questionnaire Results

	Jul 87	Aug 87	Sep 87	Oct 87	Nov 87	Dec 87	Feb 88	Mar 88	Apr 88
Mean	3.67	3.59	3.63	3.52	3.60	3.64	3.53	3.62	3.64
STD	.62	.58	.56	.61	.71	.59	.57	.52	.58

Based on scale: Poor = 1

Fair = 2

Good = 3

Exc = 4

N/A = 0

Mean Before Satellites = 3.60

Mean After Satellites = 3.59

One might like to take a look at this same measure at some time in the future to see if a change does occur. From experience, pharmacy wait times have been an irritant to users of the system for quite some time. In fact "in this era of

fast-food, instant banking, instant everything, quick service to the patient is becoming an often used criteria for good service. All too often 'how fast' is the measure of service, not 'how completely'" (Nazzaro 29). Given the recency of the change in service, customers may interpret any decrease in wait time to chance, or a "fluke". It may require repeated experiences of improved service before any change for the better is noticed in the satisfaction surveys.

The secondary aspect of this study was to validate actual patient wait times at the outpatient pharmacy. This was accomplished as described above. The results are based on a total of 1199 randomly selected patients presenting to the outpatient pharmacy over the six days of the study (appendices J through O). The findings by day are given in table 2 below and presented graphically in figure 7.

Table 2

Avg Patient Wait by Day of Study (30 Nov 87 - 17 Mar 88)

	30 Nov	2 Dec	4 Dec	7 Mar	9 Mar	17 Mar
Internal Wait	10.58	15.58	12.37	11.71	11.89	10.58
External Wait	6.72	5.22	5.22	4.00	3.78	1.33
Total Wait	17.30	20.80	17.59	15.71	15.67	11.91

Patient Wait Time Summary

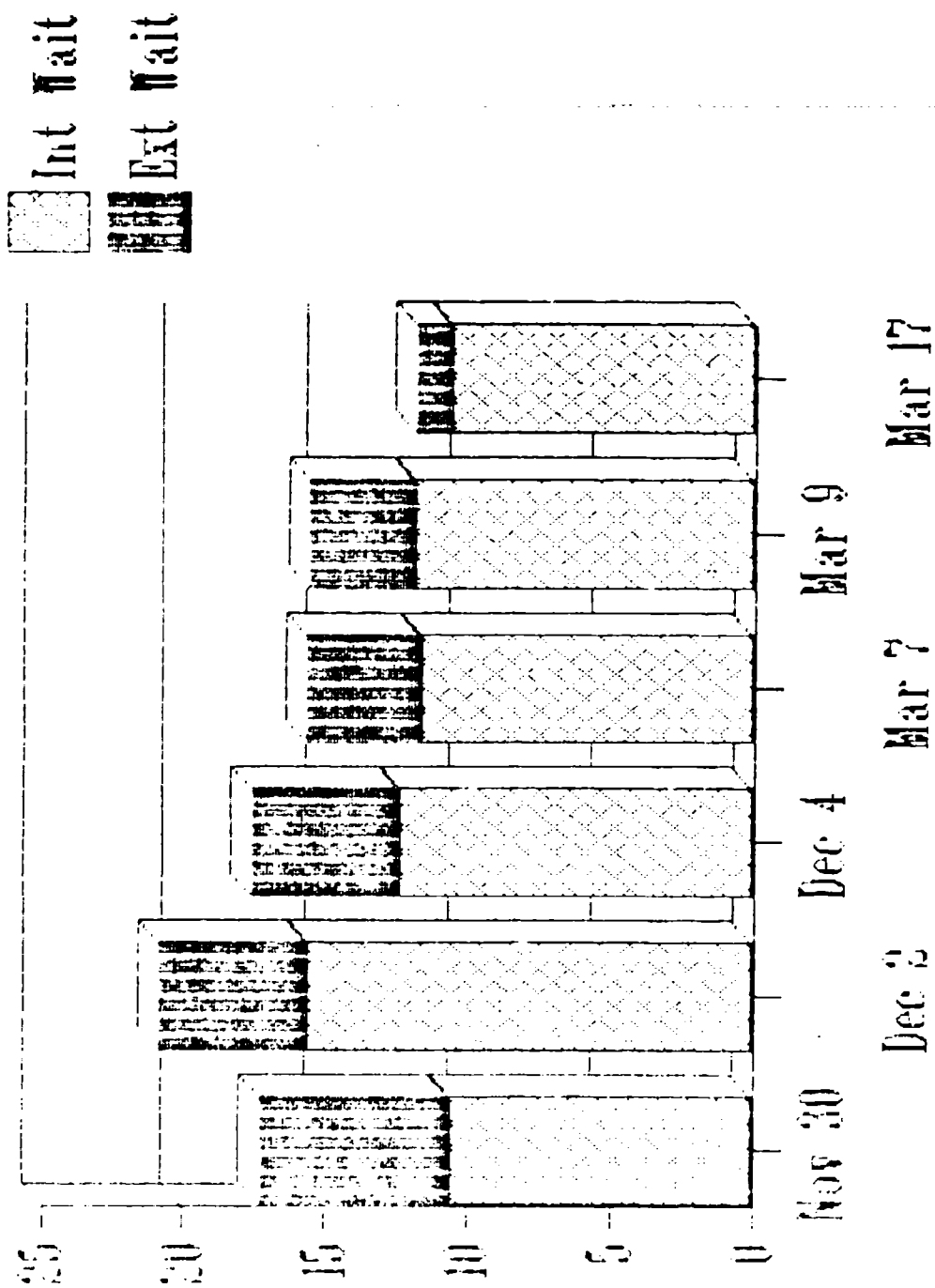


Fig. 7 Patient Wait Time Summary

In order to get a clearer picture of the change that occurred with the implementation of the satellites, the average patient wait time for the three study days before and after were determined. The "before" figures are based on an "external" wait sample size of 57 and an "internal" wait sample size of 712 (appendix F). The "after" figures are based on an "external" wait sample size of 43 and an "internal" wait sample size of 487 (appendix D). Table 3 reflects the results:

Table 3

Before Implementation:

Average External Wait = 4.75 min

Average Internal Wait = 12.90 min

Average Total Wait = 17.70 min

After Implementation:

Average External Wait = 1.80 min

Average Internal Wait = 12.10 min

Average Total Wait = 13.80 min

These figures are represented graphically in figure 8. The reduction in overall wait time appears to be significant, however, evaluation of the samples taken using appropriate statistical techniques would help support the apparent improvement in relation to the entire population. To do this, hypothesis testing is used to determine the difference between the two means (Daniel, p 177).

Patient Wait Time

Summary

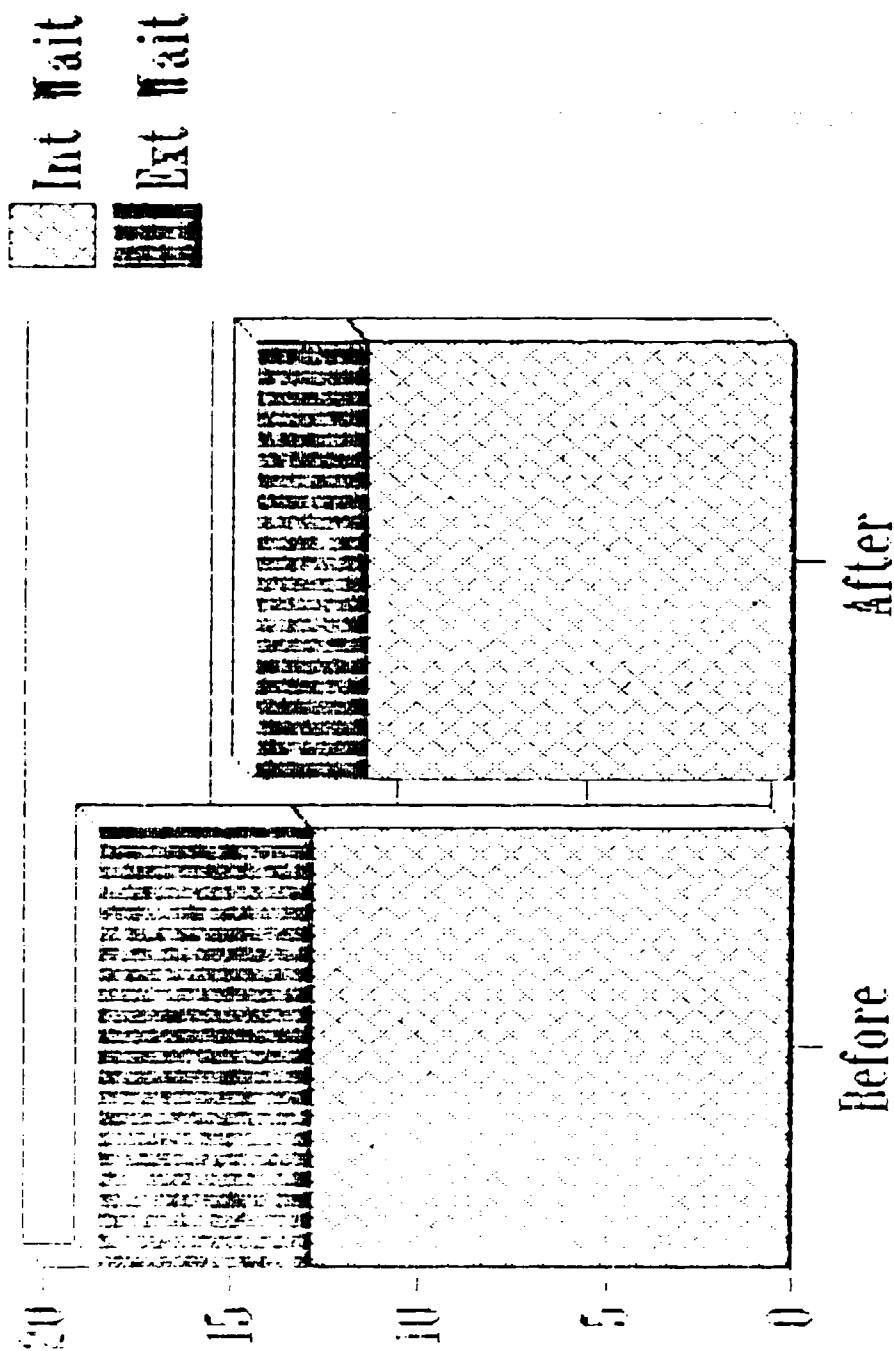


Fig. 8 Patient Wait Time Summary

The hypothesis that generated this study and was tested was that the implementation of the two satellite pharmacies would significantly reduce patient waiting times at the main outpatient pharmacy. In other words, the objective is to determine if the mean waiting time before implementation of the satellites and the wait time after are different. In order to get a better idea of where the differences exist (whether in the external or internal wait times, or both. Each will be examined separately). The nine step procedure described by Wayne W. Daniel's text, Biostatistics: A Foundation For Analysis in the Health Sciences, 3rd Edition, has been used. The calculations (appendices R and S) reveal that there is evidence to support, given a .05 level of significance, that indeed both the external and internal average wait times experienced by the beneficiary population presenting to the main outpatient pharmacy are shorter.

Recommendations

During the course of the study, observations were made not only of patient waiting times, but also of the basic operation of the pharmacy itself. As a result there are a couple of comments and recommendation regarding the provision of services at the WHMC outpatient pharmacy.

It appears that the intense involvement by pharmacy management and the support of the command section to improve services has been quite successful. The renovation of the pharmacy to incorporate the dual track system invariably had a

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It appears that the intense involvement by pharmacy management and the support of the command section to improve services has been quite successful. The renovation of the pharmacy to incorporate the dual track system invariably had a

lot to do with the reduction of patient wait times prior to this study. Visits by the researcher to the Audie L. Murphy Memorial Veterans Administration Hospital and the Brooke Army Medical Center (the two Department of Defense health care facilities in San Antonio that best compare to WHMC) reflect WHMC's patient wait time to be quite impressive.

Suggested improvements in the area of management of the service are minimal, however, consideration of these concerns may very well result in an even more improved service to the patient. The first and most significant observation was the operation of the dispensing window or window number two. The typical scenario is to man this window with a WHMC volunteer. While these individuals are indispensable in the operation of WHMC and certainly provide a much needed boost to the problems of undermanning, they are not always as well controlled as a member of the staff. It was observed on numerous occasions that delays occurred between the time a prescription had been filled and checked and the time that that patient's name was actually called. This was sometimes a result of excessive workload, but was often caused simply by confusion or inattentiveness. This situation becomes significant as these delays often resulted in an additional one to three-minute wait for the patient.

Another observation that becomes more difficult to analyze is the overall supervision of the pharmacy staff as it relates to pharmacy production. The operation of the dual track system necessitates constant flexibility in the movement of personnel to different functions at different times. At times during the study

it appeared that the responsibility to assess the current situation and determine its particular needs fell to the technicians or anyone else that felt the need for the change to take place. Often this took place as the Officer in Charge was either on leave or TDY or busy with administrative requirements.

The resolve to these issues are not easy as they involve the ever present problem of undermanning. Given that additional manning is not available, the use of the WHMC volunteers becomes imperative. In this case it is felt that a careful screening of individuals used to dispense prescriptions should be employed. Once placed, their performance should be monitored and appropriate action taken if they are unable to keep up with the operation as it is designed. To tie in with the second problem identified, closer supervision of the overall operation could identify this situation and temporary assistance could be provided if indeed the backup was caused by excessive workload. Understandably, the ability of the OIC to constantly monitor the operation is hampered by numerous military, professional and administrative requirements. However, emphasis on how personnel are distributed within the dual track system may indeed improve the operation and certainly reduce the presence of stress between the technicians that appears when they are forced to make these types of decisions. Several other problems, not related to personnel, surfaced during the study that impact on patient wait times. One of these is the efficiency of the automated pharmacy system. As with all computer systems, the speed at which they process information is directly proportionate to the amount of

information being processed. During the course of the study there were several instances in which the computers response time slowed significantly. This of course slows the process of inputting the patient's prescription, providing the various automated checks against the patient's profile and printing the appropriate labels. In the worst case scenario (as was seen on a day not captured in the study) the computer system goes down completely and the pharmacy must resort to the manual processing of labels via typewriter. While a system going down may not necessarily be within the control of the user, system speed is something that can be addressed. Periodic analysis will provide input as to when the hardware being used is no longer adequate for the job. This is of course an arbitrary decision as there is no prescribed acceptable or unacceptable response time for data processing.

Directional signage was another area of concern. While significant effort had been made to provide adequate and informative signs, confusion or neglect on behalf of the patient often negated the sign's purpose. Figure 9 depicts the outpatient pharmacy waiting area and its associated signage. Figure 10 provides the floorplan and line-of-sight for the instructional signs explaining the options available for having prescriptions filled.



Fig. 9 Outpatient Pharmacy Waiting Area

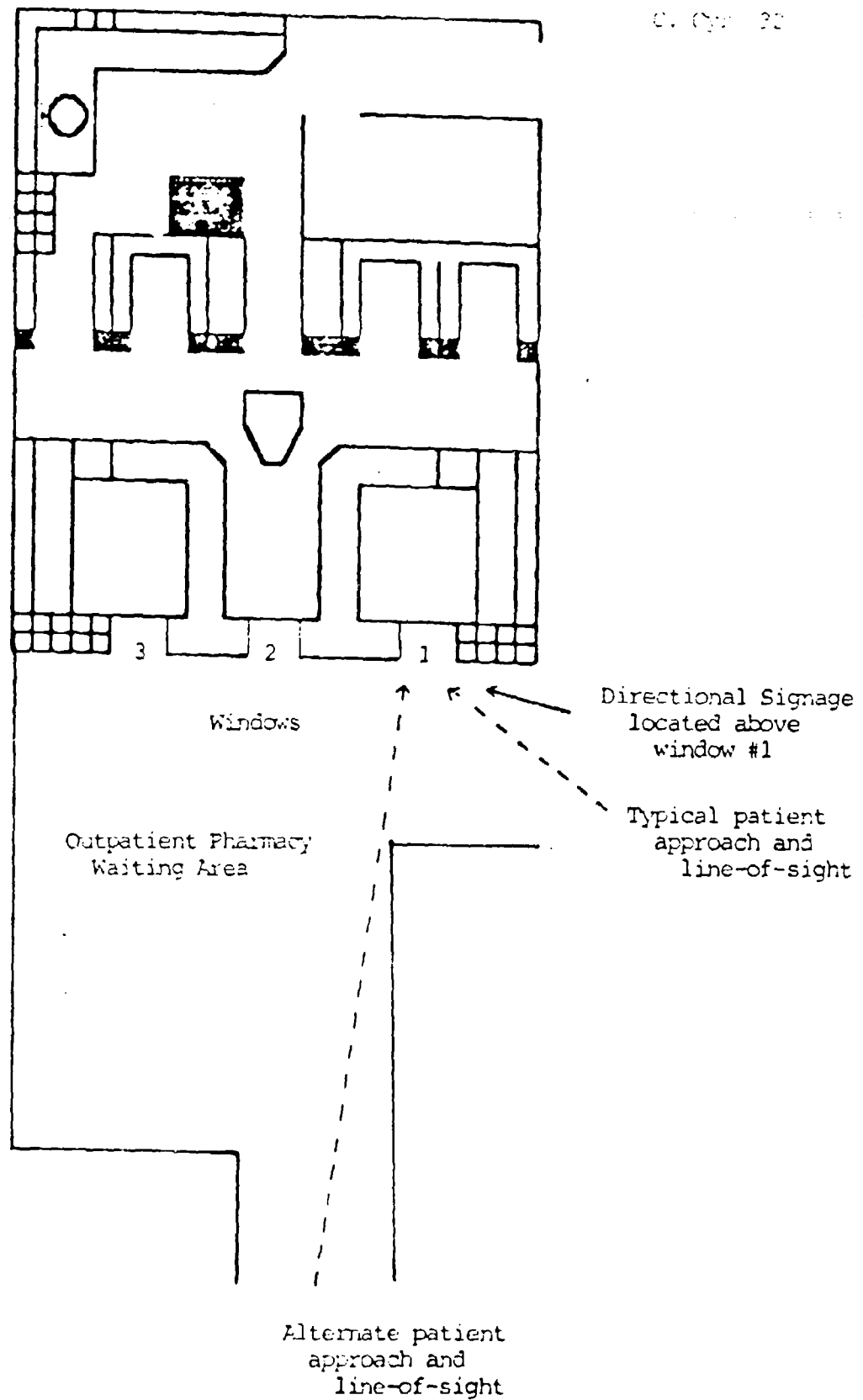


Fig. 10 Floorplan and Line-Of-Sight for Directional/Informational Signage

Observation of patients presenting to the pharmacy showed that few noticed or took time to read any signage. It is felt by the researcher that human nature tends to cause patients presenting to a service known to have long waiting lines to immediately proceed to an open window if there is no line. Given that the signage available is located above the windows, this compelling need to get to the open window precludes their reading the sign.

A proposed solution to this problem would involve moving the information signs to a location where the patient has not yet seen the window. This may draw the patient's attention to the signage as the individual is trying to determine the proper procedures as they approach the pharmacy. Suggested signage placement and traffic flow are presented in figure 11.

An area of concern that will never be totally eliminated, however, can be improved is that of incorrect, incomplete or illegible prescriptions. This takes involvement by senior management, particularly the Medical Center Commander and the Chief of Hospital Services. Although data was not collected in this study, experience at an Air Force regional hospital reflected that 1.2% of the ambulatory care drug orders required pharmacy intervention (Strate 768). This would equate to approximately 12 inquiries per day at WHMC (a figure the pharmacy staff feels is significantly understated). The pharmacy has initiated a study to determine the amount of manhours that is taken by the requirement to call providers to rectify problems.

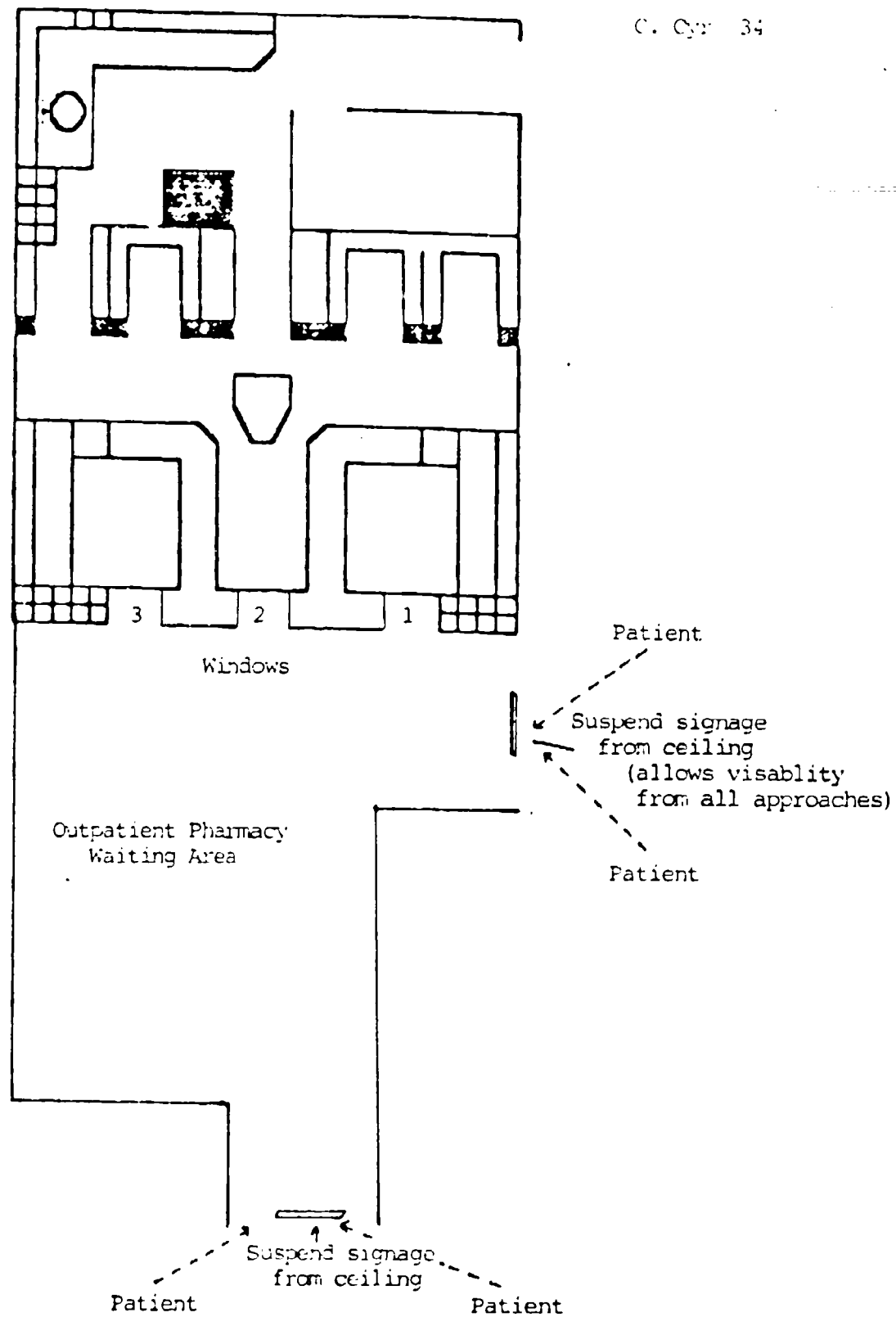


Fig. 11 Suggested signage placement

Suffice it to say it is significant and certainly affects patient wait times, particularly for those patients whose prescriptions are in question.

The last area of concern is one which is currently beyond control of the pharmacy personnel. That is the problem of inadequate space both for patient waiting and for the pharmacy itself. As stated earlier, only 575-square-feet are allocated for patient waiting and 787 square feet for the pharmacy. Discussions with the facility management personnel and review of blue prints reflect that there is no way to expand the current facility. Given these constraints, very little storage is available within the pharmacy necessitating constant restocking from a remote warehouse within the facility. This removes one full-time individual from providing more direct patient related activities and may in fact increase patient wait time as patients wait for certain drugs to be restocked. Lack of space in the patient waiting area may contribute to the significant numbers of patients who are not present when their name is called to pick up their medications. This too causes increased workload for pharmacy personnel and slows the entire process down resulting in increased patient wait times.

Chapter IV

Literature Review

While significant numbers of articles are written addressing the provision of, problems associated with, and innovative approaches to inpatient pharmacy services, only recently has there been much interest in the ambulatory care pharmacy. This may be one of the affects of the current healthcare environment in which diversification may be key to survival (Schneider 21). A survey of Hospital Chief Executive Officers found that significant numbers planned to add or expand Preferred Provider Organizations (PPOs), outpatient surgery and wellness programs (Abramowitz 1155). "The shift to outpatient medical care should encourage a major effort to develop patient-oriented cost-effective pharmaceutical services in this setting" (Abramowitz 1156). Even so, as stated by Abramowitz and Mansur in a commentary published in the American Journal of Hospital Pharmacy, "outpatient medical care is increasing dramatically as a cost effective alternative to hospital care ... (however) ... it is our opinion that comprehensive ambulatory-care pharmaceutical services are not progressing at the same rate" (1155). This opinion seems to be substantiated as very little yet appears in the literature regarding the provision of

hospital-based outpatient pharmacy services, particularly of the magnitude found at WHMC. That which does appear tends to be oriented towards capturing market share and improving the financial posture of the organization (Schneider 21-7).

The military, on the other hand, has provided extensive outpatient services for years. In fact, "throughout the federal sector, the major focus in health services is on ambulatory care" (Zellmer 745). This typically includes the provision of many pharmaceutical services. However, review of the literature in regard to either governmental or civilian studies of patient waiting times could not be found. On the other hand, several articles have appeared that address renovating existing ambulatory care pharmacies to improve the work environment, facilitate patient flow, etc., which indirectly affect patient waiting times.

One such article describes the renovation of the Yale-New Haven Hospital's outpatient pharmacy (Miller 371). This particular hospital operates 78 general and specialty clinics producing some 252,000 visits per year (as compared to WHMC's 920,000 per year). The article provides a look at the process that the pharmacy department went through to update and improve services and profitability in their ambulatory pharmacy services.

One of their prime concerns and an impetus for change was an average waiting time of 30 minutes with 45 to 60 minute waits not uncommon. The approach taken by the Yale-New Haven Hospital was to renovate, an initiative similar to that taken by WHMC prior to the study presented in this paper. Yale-New Haven's renovation

incorporated the use of SysteModules (modular office/work furniture) to accomplish improved work flow for employees while placing patients in a system that keeps them actively involved in the process. This not only decreased the wait time, but gave an impression of a shorter wait. This equates to the WHMC dual track system and use of the rotary number dispensing machine to break up the waiting cycle. The results of the above described renovation was significant as wait times were reduced to an average of eight to ten minutes from the previous 30 to 40 minutes (Miller 374). However, as there was no discussion of the methodology used in the study it may be that the increase in service time (increased from a 9 hour work day to 24 hour a day operation) caused a significant part of the improvement noted.

Review of the literature again found nothing regarding the implementation of satellite ambulatory care pharmacies. Even so, the Joint Commission on the Accreditation of Health Care Organizations (JCAHO) addresses the topic by directing that "when the hospital pharmaceutical department/service is decentralized, a licensed pharmacist, who is responsible to the director of the pharmacy department/service, supervises each satellite pharmacy" (Joint Commission 177). This leads to the unique disparity found between Department of Defense and civilian medical treatment facilities in that military pharmacy technicians are given more autonomy than their civilian counterparts.

While personnel constraints in the civilian ambulatory care setting may preclude the provision of services such as those provided by WHMC's satellite pharmacies, the presence of

qualified technicians to operate these facilities in the military setting make it a reality. The autonomy given these individuals may in part be derived from the quality training and education of military technicians. The training of support personnel in the civilian arena is "a confusing array of training programs that vary in length and are offered in a variety of sites. State regulations governing the activities that technicians may perform are inconsistent" (Anderson 1595). Nationwide there are 36 formal pharmacy technician training programs in 17 states plus three military programs. These military programs are "noted for their well-delineated functions and training of technicians" (ASHP 2562).

The United States Air Force provides one such program. It consists of a three month pharmacy training course where "technicians receive instruction in chemistry, pharmacy, mathematics, anatomy, physiology, pharmacology, and dispensing. They also receive approximately 60 hours of computer training in hospital information systems" (Strate 769). In addition, these individuals go on to advanced training throughout their careers.

This training and experience allows for the unique situation studied at WHMC with the use of satellite ambulatory care pharmacies. The military can simply use its technicians more independently than the civilian sector. Again, this may be a consideration as to why the type of satellite pharmacy in use at WHMC is not typically seen in civilian ambulatory care settings. The cost of manning such a small operation with a pharmacist may outweigh its benefit (profit margin).

Chapter V

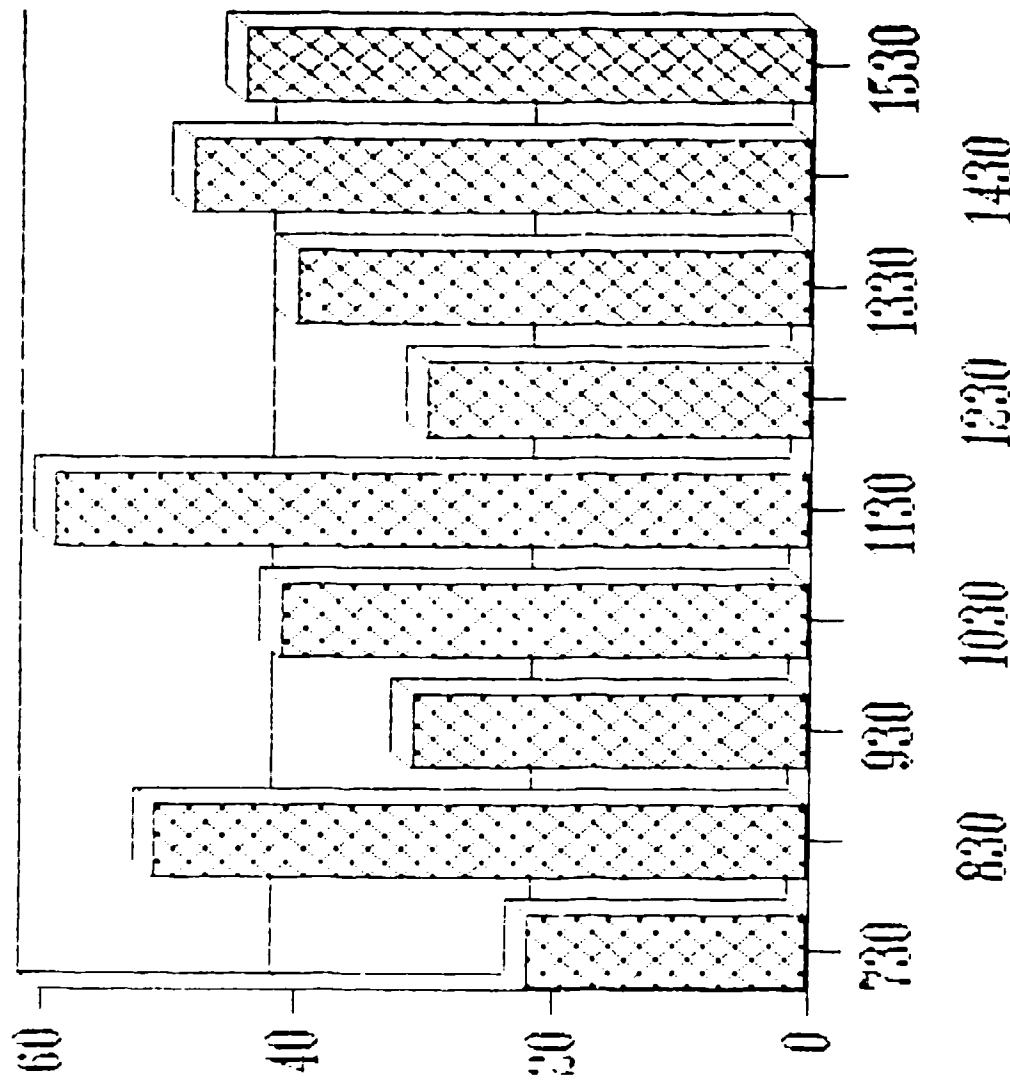
Conclusion

The bottom line for the Air Force pharmacy service (to include WHMC) is for "the pharmacist to provide timely service while ensuring a high quality of care to the rapidly expanding population of beneficiaries (Strate 766). It appears from this study the WHMC outpatient pharmacy is meeting these goals. Not only did the implementation of the two satellite pharmacies show a statistically significant change in the patient wait time at the main outpatient pharmacy, it undoubtedly has provided for less easily measured intrinsic benefits. The satellites were designed to offer patients a more convenient and better service, and this has been accomplished. For example, "moms with sick children need to be taken care of in the pediatric clinic, so they can have the medicine and go home right after seeing the doctor" (Watson 3). While not accounted for in this study, there is the factor of the time it takes a patient to travel from the clinic in which they were seen to the outpatient pharmacy. This travel has been eliminated for both the Pediatric and Primary Care clinics. This could in fact cause the findings obtained to again be somewhat understated.

Credit should be given to the staff and management of the

WHMC pharmacy service for the outstanding achievements obtained within their service to the benefit of the patient population. Given the uniqueness of the workload volume experienced at the Air Force's largest medical center, patient wait times such as depicted in this study are commendable. Hopefully the data provided in this study will provide the necessary assurance to the executive staff that; from the findings of this study, the researcher's personal observations and experience, the physical limitations imposed by the facility and extensive review of the literature, there are no significant recommendations to alter the method of service presently found in the WHMC outpatient pharmacy. The objective of an average patient wait time of 15 minutes or less established by the administrator has been met.

Patients Presenting to Window #1

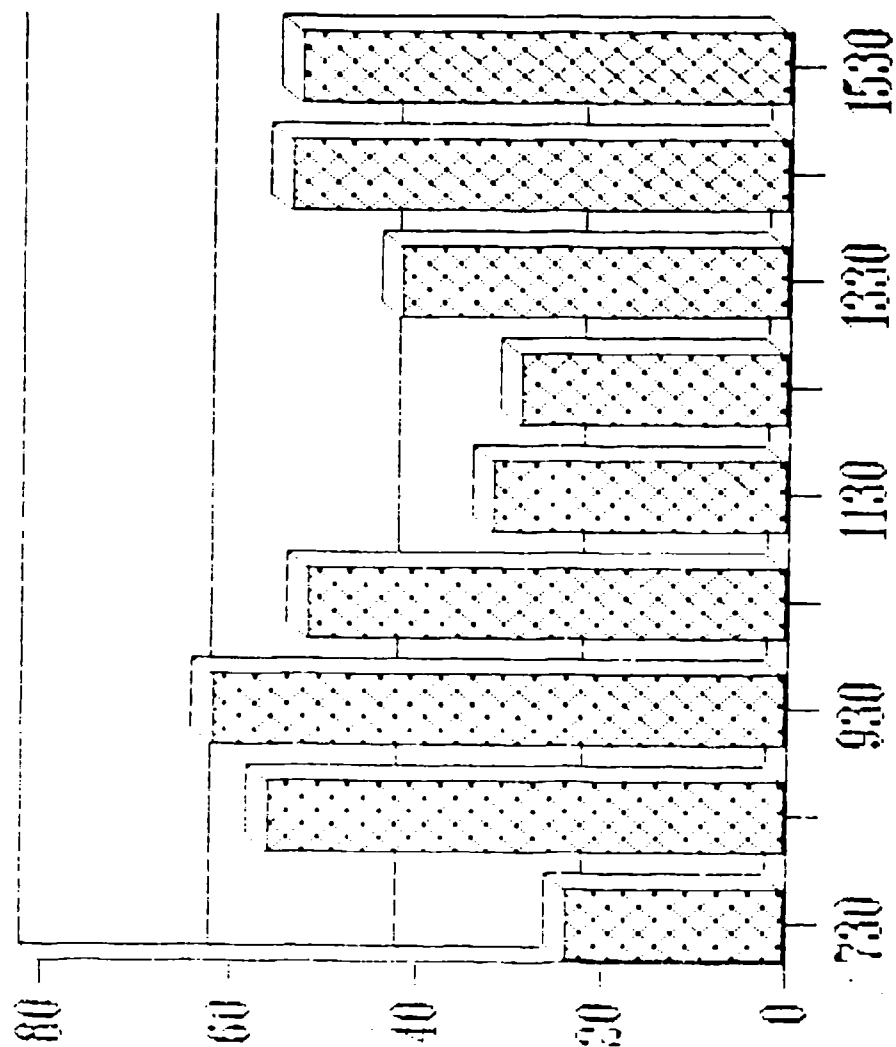


30 Nov 88

Number of
Patients

Patients Presenting to Window #1

Number of
Patients

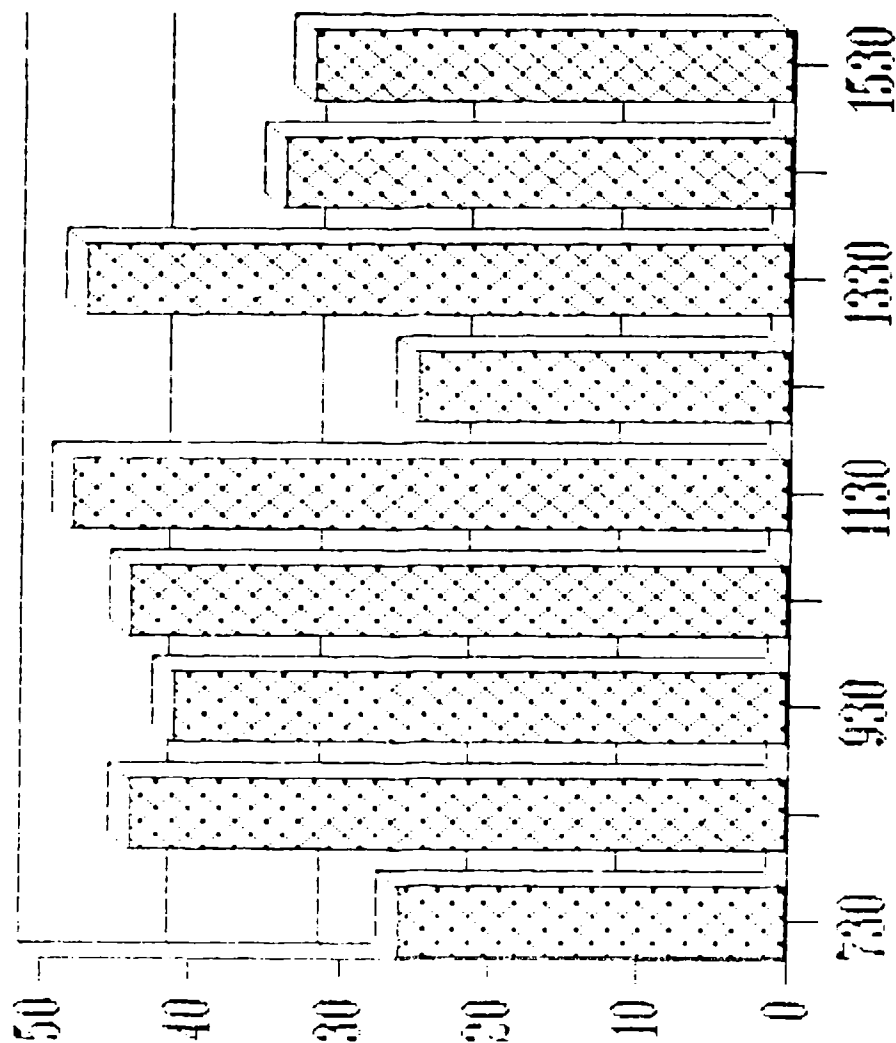


830 1030 1230 1430

2 Dec 87

Patients Presenting to

Window #1

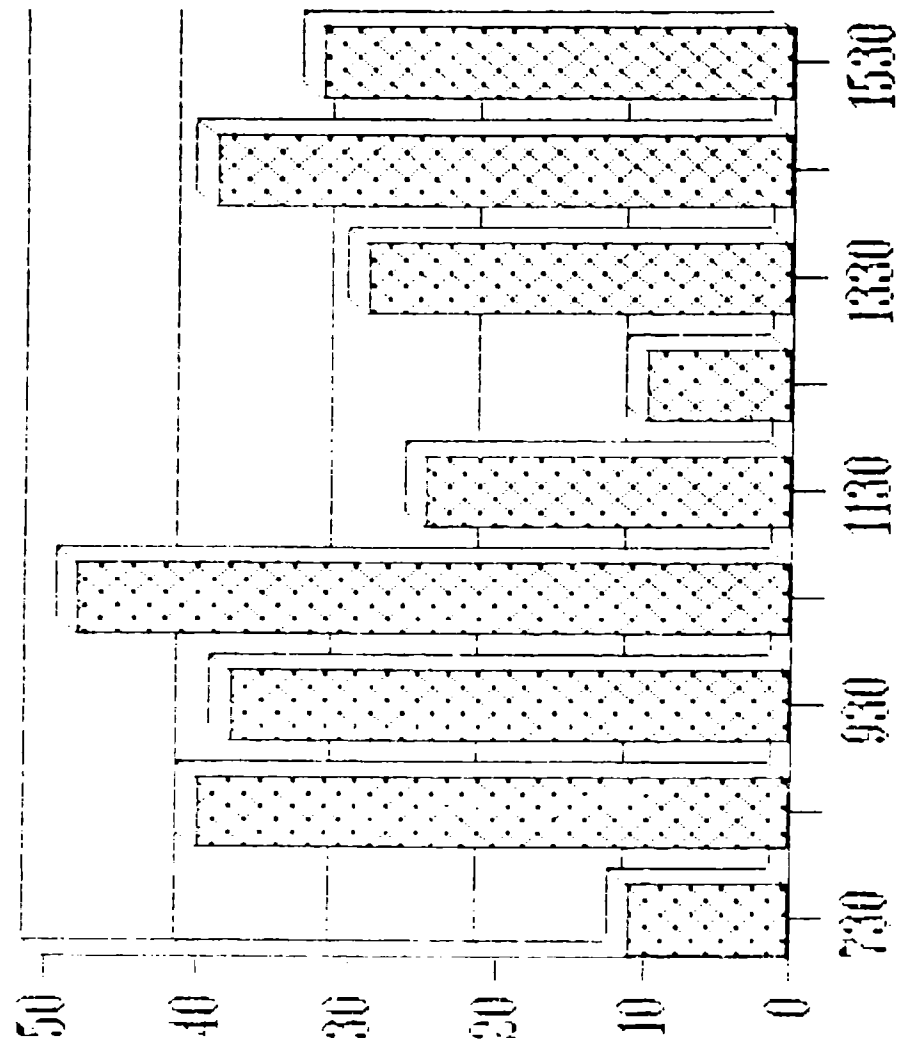


830 1030 1230 1430

4 Dec 87

Number of
Patients

Patients Presenting to Window #1



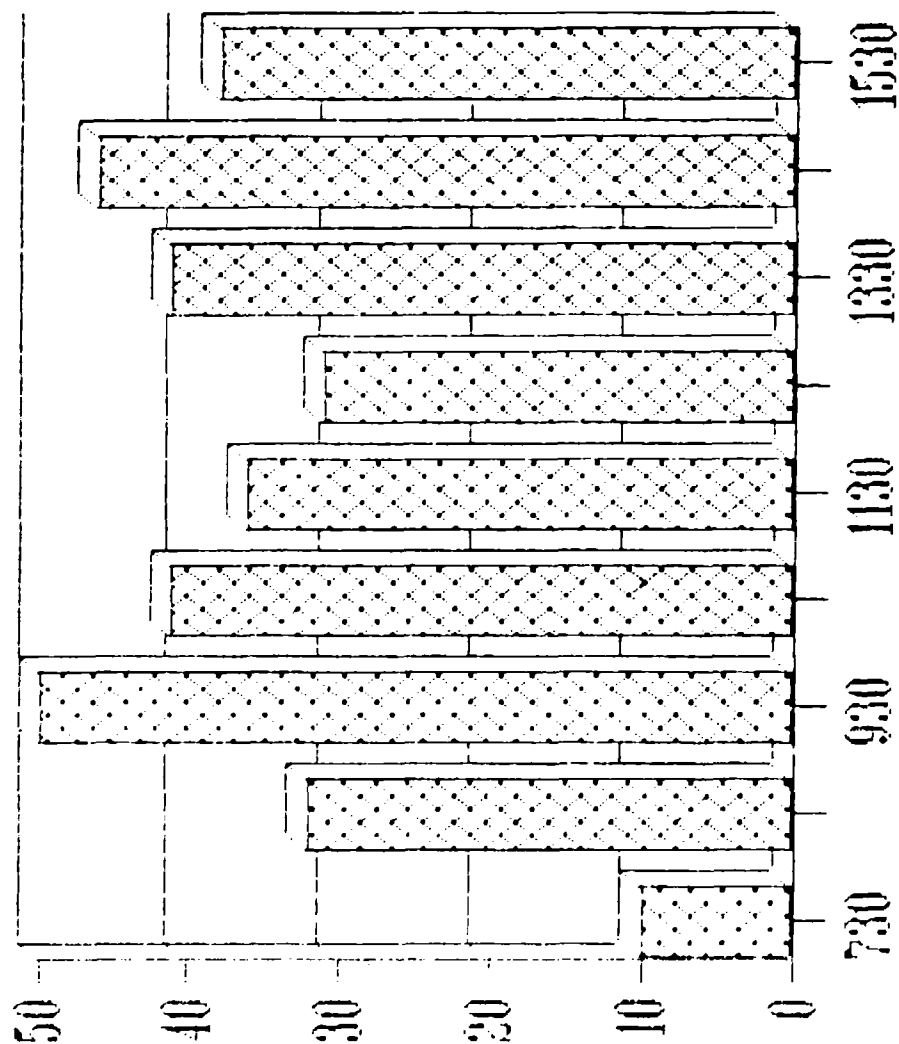
830 1030 1230 1430

7 Mar 88

Number of
Patients

Patients Presenting to

Window #1

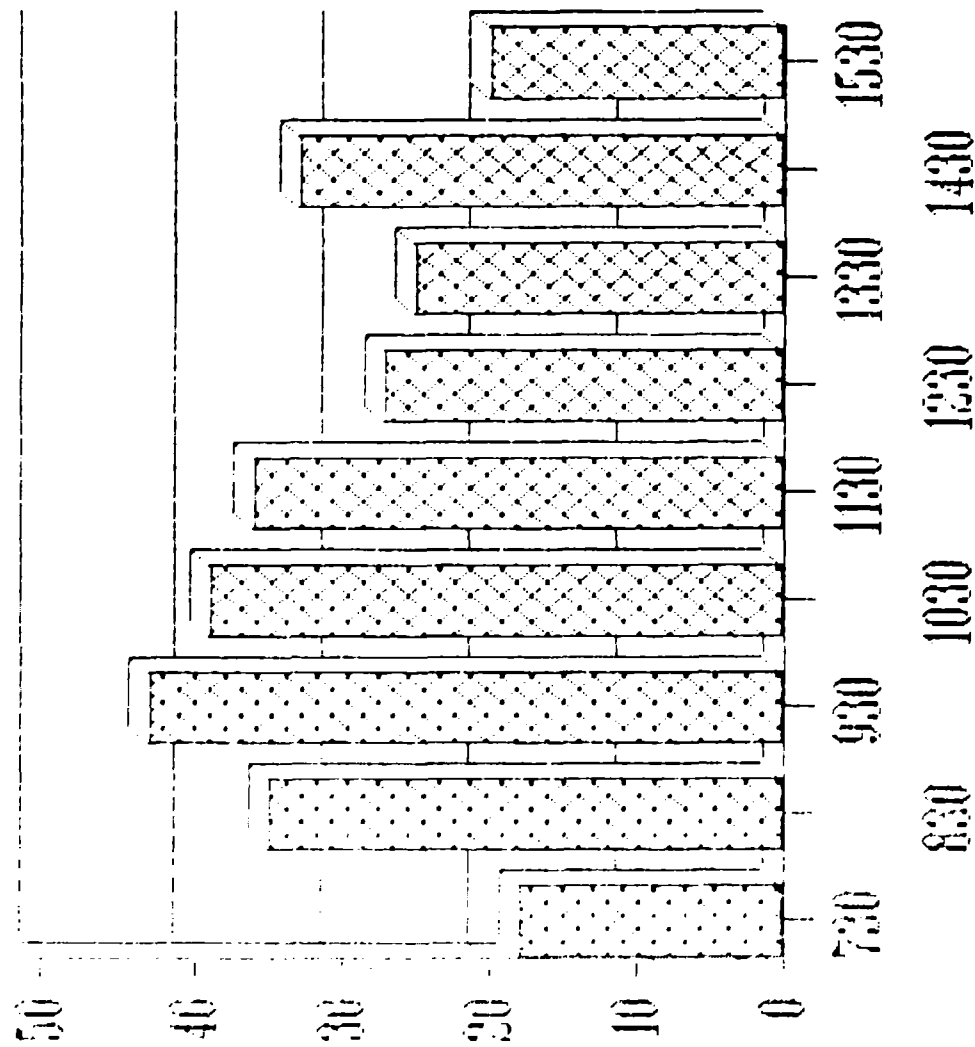


830 1030 1330 1430

9 Mar 88

Number of
Patients

Patients Presenting to Window #1



17 Mar 88

Number of
Patients

WHMC Outpatient Pharmacy Pt Wait Study - Avg Scripts per Patient

1	1	4	3	3
4	1	3	1	1
1	1	1	1	1
1	1	3	3	3
2	1	1	1	2
1	1	2	1	2
1	1	1	2	2
1	1	1	6	2
1	2	1	2	3
3	2	3	1	1
1	3	2	1	4
1	1	6	2	1
1	1	3	3	4
3	1	3	2	8
2	1	4	2	5
1	2	3	1	5
1	2	2	3	1
5	3	1	1	4
1	3	2	1	6
3	2	1	1	2

AVG	2.13
n =	100.00
Minimum	1.00
Maximum	8.00
STD	1.44

Wilford Hall USAF Medical Center Outpatient Questionnaire

Circle the number that best describes your opinion about each of the following:

Excellent Good Fair Poor N/A

1. Appointment System

a. Courtesy	4	3	2	1	0
b. Time to reach an appointment clerk	4	3	2	1	0
c. Reasonableness of appointment time	4	3	2	1	0

2. Records

a. Courtesy	4	3	2	1	0
b. Record availability	4	3	2	1	0
c. Explanation of delays	4	3	2	1	0

3. Clinic

a. Courtesy	4	3	2	1	0
b. Record availability	4	3	2	1	0
c. Waiting time	4	3	2	1	0
d. Explanation of delays	4	3	2	1	0
e. Explanation of care	4	3	2	1	0
f. Home care instructions	4	3	2	1	0
g. Caring attitude	4	3	2	1	0

4. Other Personnel Service Given By:

a. Laboratory (Blood Collectors)	4	3	2	1	0
b. X-Ray	4	3	2	1	0
c. Pharmacy	4	3	2	1	0
d. Volunteers	4	3	2	1	0
e. Other	4	3	2	1	0

5. Facility

a. Cleanliness	4	3	2	1	0
b. Lighting	4	3	2	1	0
c. Heating/AC	4	3	2	1	0
d. Noise	4	3	2	1	0
e. Parking	4	3	2	1	0
f. Directional signs in the building	4	3	2	1	0

6. Clinic Visited Today

Allergy ()	Cardiology ()	Dermatology ()
ENT ()	Emergency Room ()	Gyn ()
Hematology ()	Immunization ()	Internal Medicine ()
Mental Health ()	Neurology ()	Neurosurgery ()
Obstetrics ()	Oncology ()	Ophthalmology ()
Optometry ()	Orthopedics ()	Pediatrics ()
Physical Therapy ()	Plastic Surgery ()	Primary Care ()
Surgery ()	Urology ()	Urgent Care ()
Other ()		

Excellent Good Fair Poor N/A

7. Your overall impression of Wilford Hall Medical Center

4 3 2 1 0

In an effort to provide you with better service, please answer the following:

8. Status: AD () RET () DEP () OTHER ()

9. Age _____

10. Sex _____

11. Appointment Date _____

12. How many miles did you travel to WHMC?

Air evac ()	0-5 ()	6-10 ()
11-15 ()	16-20 ()	21-30 ()
31-40 ()	41-50 ()	+50 ()

Name _____
(A signature is welcome, but not necessary)

13. Other Comments/Suggestions: _____

WE CARE

VALUE LABEL	VALUE	FREQUENCY	PERCENT	VALID PERCENT	CUM PERCENT
POOR	1	3	1.4	1.6	1.6
FAIR	2	6	2.8	3.1	4.7
GOOD	3	43	19.8	22.5	27.2
EXC	4	139	64.1	72.8	100.0
N/A	0	26	12.0	MISSING	
TOTAL		217	100.0	100.0	
MEAN	3.665	STD ERR	.045	MEDIAN	4.000
MODE	4.000	STD DEV	.618	VARIANCE	.382
KURTOSIS	4.684	S E KURT	.350	SKEWNESS	-2.071
S E SKEW	.176	RANGE	3.000	MINIMUM	1.000
MAXIMUM	4.000	SUM	700.000		

VALID CASES 191 MISSING CASES 26

OSD

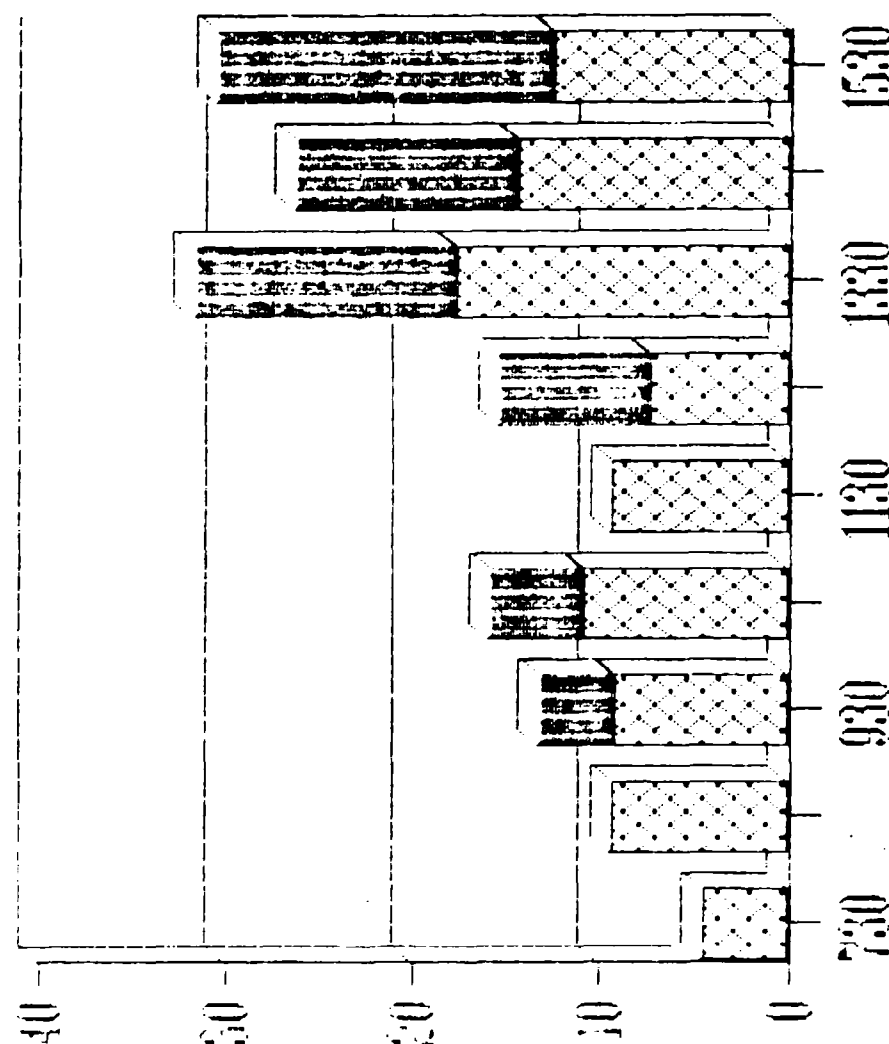
VALUE LABEL	VALUE	FREQUENCY	PERCENT	VALID PERCENT	CUM PERCENT
POOR	1	5	2.3	2.7	2.7
FAIR	2	16	7.4	8.6	11.3
GOOD	3	66	30.4	35.5	46.8
EXC	4	99	45.6	53.2	100.0
N/A	0	31	14.3	MISSING	
TOTAL		217	100.0	100.0	
MEAN	3.392	STD ERR	.056	MEDIAN	4.000
MODE	4.000	STD DEV	.758	VARIANCE	.575
KURTOSIS	.989	S E KURT	.355	SKEWNESS	-1.172
S E SKEW	.178	RANGE	3.000	MINIMUM	1.000
MAXIMUM	4.000	SUM	631.000		

VALID CASES 186 MISSING CASES 31

Patient Waiting Times

30 Nov 87

Int Wait
Ext Wait



8:30 10:30 12:30 14:30

Time of Day

Wait Time
in Minutes

WPC Outpatient Pharmacy Patient Waiting Time Study - 30 Nov 87

0730-0830	0831-0930	0931-1030	1031-1130	1131-1230	1231-1330	1331-1430	1431-1530	1531-1630
730	830	930	1030	1130	1230	1330	1430	1530
5	6	12	12	10	11	16	20	11
7	7	11	15	9	6	20	20	11
8	9	12	15	9	13	20	20	12
10	9	13	12	8	19	18	25	13
5	6	9	14	6	12	20	22	11
5	10	17	14	5	5	24	23	11
6	11	12	12	7	11	19	24	10
4	15	12	12	10	8	16	19	10
3	13	14	6	10	11	39	18	6
3	15	14	7	10	5	27	20	16
5	24	9	7	15	4	4	20	9
3	16	13	7	16	6	27	4	4
2	17	13	4	5	7	4	24	14
2	12	5	7	5	7	7	26	7
2	5	5	5	11	9	4	9	10
3	6	10	5	12	5	18	13	10
	6	14	12	8	5	18	13	10
	6	9	9	7	4	18	12	15
	6	9	9	11	2		10	15
	6	6	12	9	4		5	29
	6	8	12	12	6		6	16
	11	4	9		6		5	16
	5	8	12		3		7	21
	2	11	11				8	
	6	12	10				9	
		3	15				11	
		6	9				9	
		3	15				9	
		5	9				23	
		4	12				9	
		3	14				5	
			14				4	
			11				18	
			14				15	
			17					
			15					
			8					
			11					

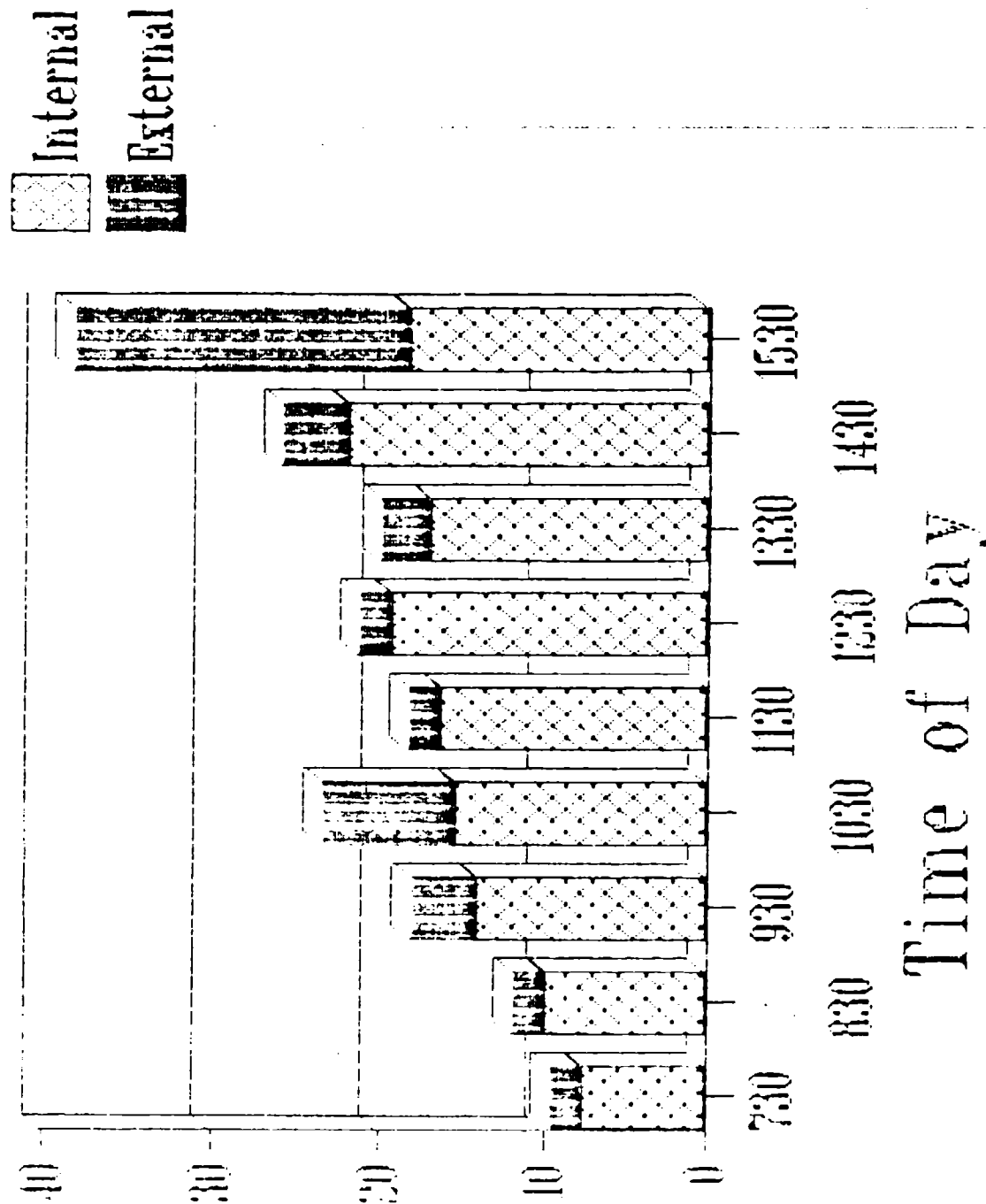
Mean	5	9	9	11	9	7	18	14	12
n =	16	25	31	38	21	23	18	34	23
N =	22	51	31	41	59	30	40	48	44
Daily Mean	10.56								

WMC Outpatient Pharmacy Patient Waiting Time Study - 30 Nov 87

Avg Wait for no. to be called	0	0	4	5	0	8	14	12	18
Daily Avg wait for no. to be called	6.78								
Avg Daily Wait	17.35								
STD	2	5	4	3	3	4	9	7	5
VAR	5	24	15	11	9	15	76	49	26
Min Wait	2	2	7	9	5	10	18	16	22
Max Wait	10	24	21	22	16	27	53	38	47
	6								
	35								

Patient Waiting Times

2 Dec 87



Wait Times
in Minutes

WMC Outpatient Pharmacy Patient Waiting Time Study - 2 Dec 87

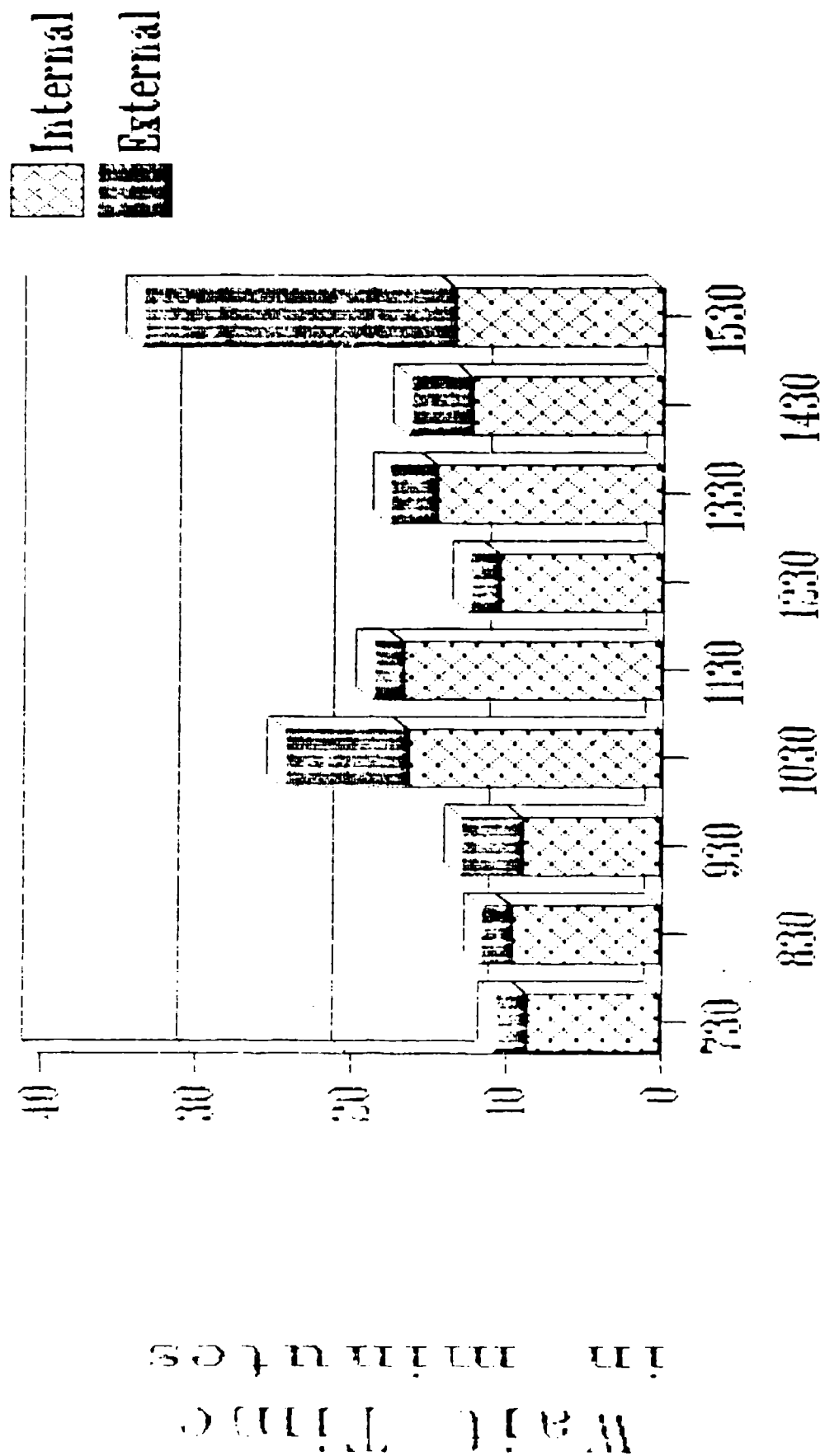
	0730-0830	0831-0930	0931-1030	1031-1130	1131-1230	1231-1330	1331-1400	1401-1530	1531-1630
	730	830	930	1030	1130	1230	1330	1430	1530
	6	10	12	25	25	18	32	23	28
	13	10	17	20	16	23	27	31	26
	6	10	21	25	21	17	10	26	23
	4	5	14	26	18	21	15	26	32
	5	6	6	30	20	24	18	22	25
	5	4	9	17	15	21	7	8	21
	3	8	10	26	17	24	23	29	8
	6	6	16	23	14	10	11	30	17
	6	5	16	21	14	13	19	24	24
	8	4	13	31	14	10	7	18	20
	3	7	15	22	13	11	11	23	14
	5	6	13	23	16	17	19	23	14
	10	4	15	9	16	32	31	13	21
	16	4	14	8	14	20	17	16	12
	11	3	12	18	16	16	13	19	10
	7	11	15	18	19	28	17	26	12
	13	6	15	13	7	16	28	26	12
	10	15	15	7	7	23	16	26	11
		8	17	13	13	24	17	23	27
		8	14	9	12		11	26	12
		8	15	8	13		10	20	16
		5	10	11	13		15	20	
		14	13	13	31		14	19	
		15	16	22	22		18	23	
		14	15	13	18			17	
		16	15	8	19			21	
		18	12	6				12	
		18	15	9				20	
		16	11	4				19	
		18	12	10				32	
		14	13	5					
		18	13	5					
		12	13	9					
		13	17	8					
		7	4	15					
		12	27	18					
		8	20	18					
		12	23	21					
		14	18	20					
		9	4						
		12							
Mean	8	10	14	16	16	19	17	22	18
n =	18	41	40	39	26	19	24	30	21
n =	24	56	62	52	32	29	42	54	53
Daily Mean	15.58								

WMC Outpatient Pharmacy Patient Waiting Time Study - 2 Dec 87

Avg Wait for no. to be called	2	2	4	8	2	2	3	4	20
Daily Avg Wait for no. to be called	5.22								
Avg Daily Wait	20.81								
STD	4	5	4	7	5	6	7	5	7
VAR	13	21	19	55	25	34	47	30	46
Min Wait	5	5	8	12	9	12	10	12	28
Max Wait	18	20	31	39	33	34	35	36	52
Tot STD	7								
Tot VAR	48								

Patient Waiting Times

4 Dec 87



Time of Day

WMC Outpatient Pharmacy Patient Waiting Time Study - 4 Dec 87

0730-0830	0831-0930	0931-1030	1031-1130	1131-1230	1231-1330	1331-1400	1401-1530	1531-1630
750	830	930	1030	1130	1230	1330	1430	1530
18	6	8	26	9	21	17	22	11
11	8	11	18	19	14	9	23	16
5	8	7	11	25	14	14	5	19
6	8	8	15	13	14	15	16	4
15	21	11	16	13	14	14	4	5
5	5	7	33	13	9	15	19	10
4	7	4	21	30	13	15	16	18
7	9	7	17	32	9	15	16	23
3	15	3	27	14	12	17	5	31
5	10	5	18	21	9	17	8	14
12	9	5	30	17	9	15	14	20
16	7	6	3	15	5	17	14	16
10	4	10	19	17	3	11	17	17
6	11	10	15	17	4	17	20	7
7	4	10	15	11	9	14	18	8
	10	10	24	9	5	16	10	21
	7	6	13	16	9	10	6	8
	4	10	22	15	15	7	9	10
	5	5	15	10	11	19	5	5
	19	12	18		10	10	9	6
	16	7	15			13	8	
	10	8	16			9	8	
	9	10	10			19		
	8	7	20			21		
	12	7	18			15		
	13	8	19			16		
	9	18	13			19		
	14	19	10					
	15	11	7					
	12	6	10					
	7	6	17					
		7	8					
		11	6					
		12	10					
		12						
		11						
		15						
		7						

Mean	9	10	9	16	17	10	15	12	14
n =	15	31	38	34	19	20	27	22	20
N =	26	44	41	44	48	25	47	34	32
Relly Mean	12.37								

West Outpatient Pharmacy Patient Waiting Time Study - 4 Dec 87

Avg wait for no. to be called	2	2	4	8	2	2	3	4	20
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Daily Avg wait for no. to be called	5.22
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Avg Daily wait	17.60
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STD	5	4	3	7	6	4	3	6	7
VAR	21	18	12	44	40	18	12	35	50

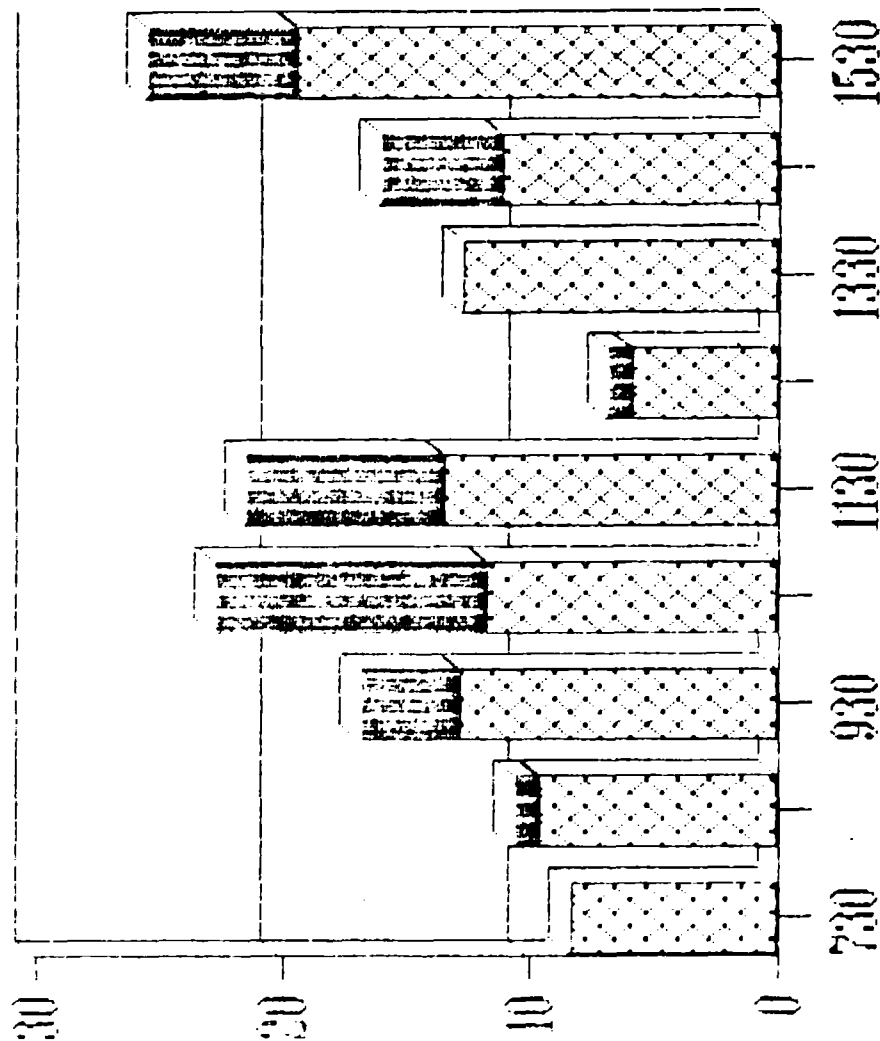
Min wait	5	6	7	11	11	5	10	8	24
Max wait	20	23	23	41	34	23	24	27	51

Tot STD	6
Tot VAR	21

Patient Waiting Times

7 Mar 88

Internal
External



830 1030 1230 1430

Time of Day

Wait Times
in minutes

WMC Outpatient Pharmacy Patient Waiting Time Study - 7 March 1988

0730-0830	0831-0930	0931-1030	1031-1130	1131-1230	1231-1330	1331-1400	1401-1530	1531-1630
730	830	930	1030	1130	1230	1330	1430	1530
4	12	16	26	27	8	17	14	15
3	15	9	18	19	5	9	25	15
7	8	13	11	23	4	14	33	15
6	10	27	6	21	5	9	16	17
12	9	15	11	11	4	12	15	17
18	9	9	17	37	7	3	15	19
	9	28	12	22	8	3	7	21
	10	14	12	13	4	3	5	6
	7	12	6	11	6	16	6	21
	8	16	5	16	8	19	5	16
	7	10	13	11	6	20	8	14
	6	11	6	13		16	10	15
	9	13	10	9		17	9	23
	11	17	5	12		17	11	16
	9	6	10	5		16	6	17
	8	4	12	14			9	26
	12	8	11	5			9	45
	10	9	12	7			9	28
	12	4	7	5			8	18
	9	11	16	6			4	27
	6	15	22	4			7	
	8	10	11	5			15	
	5	12						
	19	12						
	12	15						
		13						
		17						

Mean	8	10	13	12	13	6	13	11	20
n =	6	25	27	22	22	11	15	22	20
N =	11	40	38	48	25	10	29	39	32
Daily Mean	11.71								

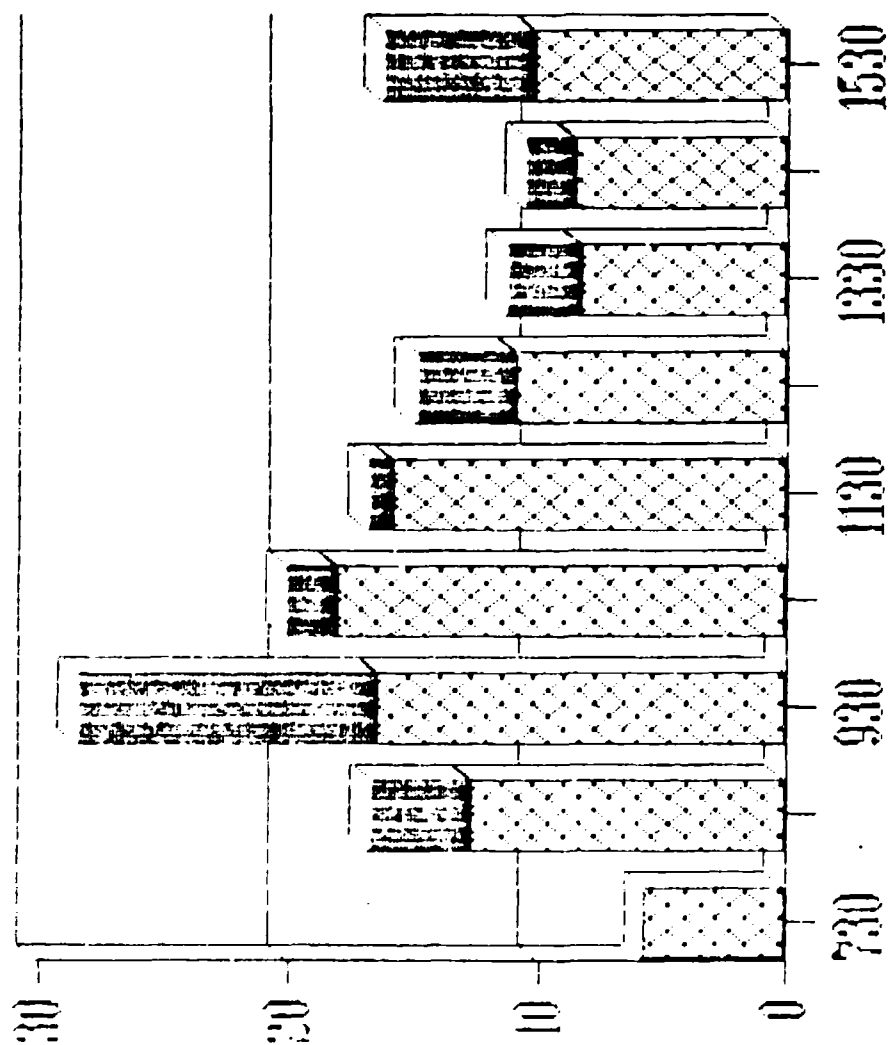
HMC Outpatient Pharmacy Patient Waiting Time Study - 7 March 1958

Avg Wait for no. to be called	0	1	4	11	8	1	0	5	6
Daily Avg Wait for no. to be called	4.00								
Avg Daily wait	15.71								
STD	5	3	5	5	8	2	6	7	8
VAR	27	9	29	28	69	2	33	45	59
Min Wait	3	6	8	16	12	5	3	9	12
Max Wait	18	20	32	37	45	9	20	38	51
	7								
	46								

Patient Waiting Times

9 Mar 88

Internal
External



Time of Day

Wait Time
in minutes

WMC Outpatient Pharmacy Patient Waiting Time Study - 9 Mar 88

0730-0830	0831-0930	0931-1030	1031-1130	1131-1230	1231-1330	1331-1400	1401-1530	1531-1630
730	830	930	1030	1130	1230	1330	1430	1530
9	12	7	11	29	11	16	6	11
4	7	16	22	32	6	21	10	11
3	13	15	15	36	9	16	8	11
4	5	20	13	32	3	11	8	12
9	14	20	14	24	9	9	7	4
8	10	15	14	9	9	9	7	15
3	10	12	13	9	14	8	8	11
6	11	18	9	6	22	7	3	9
5	12	14	23	6	16	5	4	18
3	13	15	24	1		5	9	6
	12	8	26	2		5	10	5
	15	16	26	4		6	6	
	12	20	17			6	8	
	23	17	28			6	20	
	10	19	23			6	23	
	15	22	23			4	13	
	15	8	28			4	8	
	16	19	11			6	5	
	15	20	13				6	
	16	21	13				6	
		26	26				5	
		16	7					
		16	6					
		17	22					
			19					
			27					
			12					
			17					
			22					

Mean	6	13	17	18	16	11	8	9	10
n =	10	20	24	29	12	9	18	21	11
N =	10	32	50	41	36	31	41	46	38
Daily Mean	11.89								

WMC Outpatient Pharmacy Patient Waiting Time Study - 9 Mar 86

Avg Wait
for no. to
be called

0 4 12 2 1 4 3 2 6

Daily Avg
wait for no.
to be called

3.78

Avg Daily
wait

15.67

STD

2 4 4 7 13 5 5 5 4

VAR

6 13 20 43 167 28 21 23 16

Min Wait

3 9 19 8 2 7 7 5 10

Max Wait

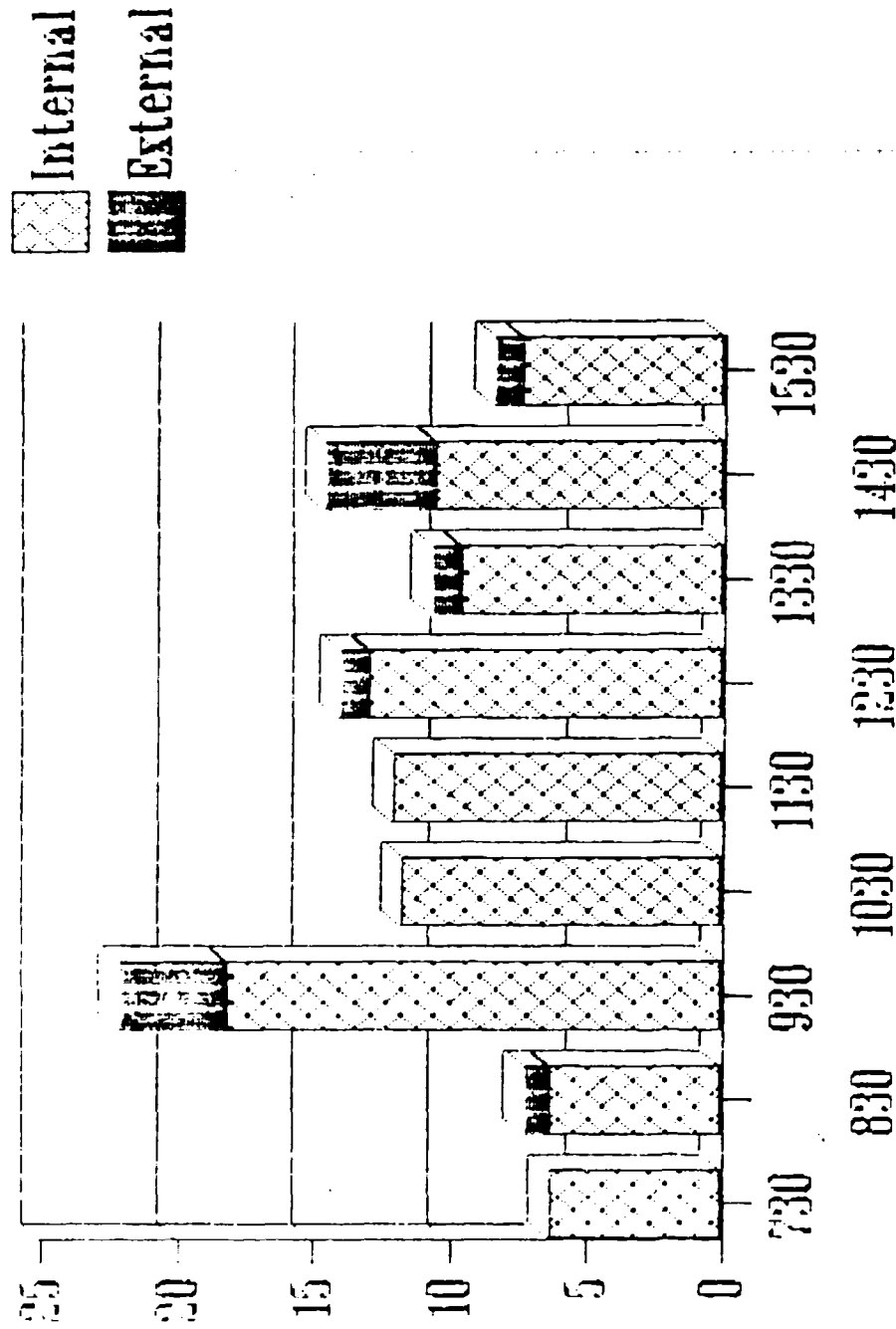
9 27 38 30 37 26 24 25 24

7

52

Patient Waiting Times

17 Mar 88



Time of Day

Wait Time
in minutes

MMC Outpatient Pharmacy Patient Waiting Time Study - 17 Mar 86

0730-0830	0831-0930	0931-1030	1031-1130	1131-1230	1231-1330	1331-1400	1401-1530	1531-1630
730	830	930	1030	1130	1230	1330	1430	1530
8	9	42	13	14	11	9	19	9
5	6	14	11	18	9	18	12	10
7	12	30	5	11	23	9	6	13
4	3	21	20	10	19	11	10	9
6	4	17	7	6	23	9	8	12
7	6	12	19	3	7	13	10	8
4	9	12	11	17	7	7	12	4
8	7	20	12	15	13	12	10	4
3	6	17	16	14	15	7	5	3
12	5	25	17	12	15	18	5	4
	10	23	17	16	17	10	8	5
	6	14	9	6	8	11	10	
	8	22	10	14	9	6	12	
	4	19	11	8	10	4	14	
	7	14	11	9	8	6	12	
	3	15	4	21		5	16	
	8	20	7	11			11	
	3	16	5					
	4	10	8					
		7	12					
		29	13					
		17	18					
		18	20					
		26	14					
		14	13					
		21	11					
		6	7					
		21	8					
		12						
		10						

Mean	6	6	18	12	12	13	10	11	7
n =	10	19	30	28	17	15	16	17	11
k =	18	35	43	39	36	27	25	33	20
Daily Mean	10.56								

WMC Outpatient Pharmacy Patient Waiting Time Study - 17 Mar 88

Avg Wait for no. to be called	0	1	4	0	0	1	1	4	1
Daily Avg wait for no. to be called	1.33								
Avg Daily wait	11.91								
STD	2	2	7	5	5	5	4	4	3
VAR	6	6	54	20	21	28	16	13	11
Min. Wait	3	4	10	4	3	8	5	9	4
Max. Wait	12	13	46	20	21	24	19	23	14
	6								
	38								

Before implementation of satellites:

Internal Wait (in minutes)

5	12	7	16	16	9	10	7	17	8	13	8	12	19	11	17
7	11	7	5	39	5	16	12	4	15	10	29	12	16	6	8
8	12	7	5	27	4	11	8	27	18	11	30	11	10	6	6
10	13	4	11	4	18	7	12	20	18	17	24	27	9	7	10
5	9	7	12	27	15	13	14	23	21	32	18	12	8	11	9
5	17	5	8	4	11	10	9	18	20	20	23	16	12	12	19
6	12	5	7	7	11	10	12	4	25	16	23	18	13	12	25
4	12	12	11	4	12	10	12	25	16	28	13	11	9	11	13
3	14	9	9	18	13	10	17	20	21	16	16	5	14	15	13
3	14	9	12	18	11	5	21	25	18	23	19	6	15	7	13
5	9	12	11	18	11	6	14	26	20	24	26	15	12	26	30
3	13	12	6	20	10	4	6	30	15	32	26	5	7	18	32
2	13	9	13	20	10	8	9	17	17	27	26	4	8	11	14
2	5	12	19	20	6	6	10	26	14	10	23	7	11	15	21
2	5	11	12	25	16	5	16	23	14	15	26	3	7	18	17
36	10	10	5	22	9	4	16	21	14	18	20	5	8	33	15
7	14	15	11	23	4	7	13	31	13	7	20	12	11	21	17
9	9	9	8	24	14	6	15	22	16	23	19	16	7	17	17
9	9	15	11	19	7	4	13	23	16	11	23	10	4	27	11
6	6	9	5	18	10	4	15	9	14	19	17	6	7	18	9
10	8	12	4	20	10	3	14	8	16	7	21	7	3	30	16
11	4	14	6	20	10	11	12	18	19	11	12	6	5	3	15
15	8	14	7	4	15	6	15	18	7	19	20	8	6	19	10
13	11	11	7	24	15	15	15	13	7	31	19	8	5	15	21
15	12	14	9	26	29	8	15	7	13	17	32	8	10	15	14
24	3	17	5	9	16	8	17	13	12	13	28	21	10	24	14
16	6	15	5	13	16	8	14	9	13	17	26	5	10	13	14
17	3	8	4	13	21	5	15	8	13	28	23	7	10	22	14
12	5	11	2	12	6	14	10	11	31	16	32	9	6	15	9
5	4	10	4	10	13	15	13	13	22	17	25	15	10	18	13
6	3	9	6	5	6	14	16	22	18	11	21	10	6	15	9
6	12	9	6	6	4	16	15	13	19	10	8	9	13	16	12
6	15	8	3	5	5	18	15	8	18	15	17	7	7	10	9
6	15	6	16	7	5	18	12	6	23	14	24	4	8	20	9
6	12	5	20	8	3	16	15	9	17	18	20	11	10	18	5
6	14	7	20	9	6	18	11	4	21	23	14	4	7	19	3
11	14	10	18	11	6	14	12	10	24	31	14	10	7	13	4
5	12	10	20	9	8	18	13	5	21	26	21	7	8	10	9
2	12	10	24	9	3	12	13	5	24	26	12	4	18	7	5
6	6	15	19	23	5	13	13	9	10	22	10	5	19	10	9

n = 712

Mean = 12.9

STD = 6.66

External Wait (in minutes)

0	10	2	8	0	3	0	9	0	2	2	1	0	0	2	1
0	4	2	0	8	0	0	0	0	4	5	0	8	10	17	14
1	3	3	2	3	5	4	9	6	8	3	0	0	2	3	4

n = 57

STD = 3.23

Mean = 4.75

Avg Total Wait
Before 17.7

After implementation of satellites:

Internal wait (in minutes)

4	11	11	17	18	8	22	8	12	21	12	10
3	13	37	16	27	16	29	8	3	6	16	8
7	17	22	14	9	20	32	7	4	21	6	10
6	6	13	25	4	17	36	7	6	12	14	12
12	4	11	33	3	19	32	8	9	10	8	10
18	8	16	16	4	22	24	3	7	13	9	5
12	9	11	15	9	8	9	4	6	11	21	5
15	4	13	15	8	19	9	9	5	5	11	8
8	11	9	7	3	20	6	10	10	20	11	10
10	15	12	5	8	21	6	6	6	7	9	12
9	10	5	6	5	26	1	8	8	19	23	14
9	12	14	5	3	16	2	20	4	11	19	12
9	12	5	8	12	16	4	23	7	12	23	16
10	15	7	10	7	17	11	13	3	16	7	11
7	13	5	9	13	11	6	8	8	17	7	9
8	17	6	11	5	22	9	5	3	17	13	10
7	26	4	6	14	15	3	6	4	9	15	13
6	18	5	9	10	13	9	6	42	10	15	9
9	11	8	9	10	14	9	5	14	11	17	12
11	6	5	9	11	14	14	11	30	11	8	8
9	11	4	8	12	13	22	11	21	4	9	4
8	17	5	4	13	9	16	11	17	7	10	4
12	12	4	7	12	23	16	12	12	5	8	3
10	12	7	15	15	24	21	4	12	8	9	4
12	6	8	15	12	26	16	15	20	12	18	5
9	5	4	15	23	26	11	11	17	13	9	10
6	13	6	15	10	17	9	9	25	18	11	21
8	6	8	17	15	28	9	16	23	20	9	17
5	10	6	17	15	23	8	6	14	14	13	28
19	5	17	19	16	23	7	5	22	13	7	15
12	10	9	21	15	26	5	8	19	11	12	17
16	12	14	6	16	11	5	5	14	7	7	10
9	11	9	21	7	13	5	7	15	8	18	6
13	12	12	16	16	13	6	4	20	14	10	14
27	7	3	14	15	26	6	7	16	18	11	14
15	16	3	15	20	7	6	6	10	11	6	6
9	22	3	23	20	6	6	4	7	10	4	
28	11	16	16	15	22	4	8	29	6	6	
14	27	19	17	12	19	4	3	17	3	5	
12	19	20	26	18	27	6	12	18	17	19	
16	23	16	45	14	12	6	9	26	15	12	

n = 487
Mean = 12.1
STD = 6.73

External Wait (in minutes)

0	0	7	3	4	6	2	15	9	2	2	0	0	3	5	4
5	0	0	0	3	10	4	2	0	0	0	0	0	0	2	2
0	0	4	2	0											

n = 43 STD = 3.16 Avg Total Wait 13.8
Mean = 1.8

The Difference Between Two Population Means,
External Wait Time

1. Data - The data consists of patient wait times in the main pharmacy from the time they arrive and take a number to the time that their number is called. Sample size was 57 before and 43 after.

2. Assumptions - The data constitute two independent random samples, each drawn from a normally distributed population. The population variances are unknown but assumed to be equal.

3. Hypothesis - $H_0: \mu_1 - \mu_2 = 0$, $H_a: \mu_1 - \mu_2 \neq 0$

4. Test Statistic -

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{S_p^2}{n_1} + \frac{S_p^2}{n_2}}}$$

5. Distribution of Test Statistic. When the null hypothesis is true, the test statistic follows Student's t distribution with $n_1 + n_2 - 2$ degrees of freedom.

6. Decision Rule - Let $\alpha = .05$. The critical values of t are ± 1.6602 . Reject H_0 unless $-1.6602 < t_{\text{computed}} < 1.6602$.

7. Computed Test Statistic - For External Wait:

$$S_p^2 = \frac{(57-1)3.23^2 + (43-1)3.1^2}{57+43-2}$$

$$= 10.24$$

$$t = \frac{(4.75 - 1.8) - 0}{\sqrt{\frac{10.24}{57} + \frac{10.24}{43}}}$$

$$t = 7.0238$$

8. Statistical Decision - Reject the H_0 since 7.0238 is greater than 1.6602.

9. Conclusion - Conclude that, on the basis of these data, there is an indication that the means are not equal.

The Difference Between Two Population Means,
Internal Wait Time

1. Data - The data consists of patient wait times in the main pharmacy from the time they turn in their prescription upon having their number called to the time their name is called to pick up their drugs. Sample size was 712 before and 487 after.
2. Assumptions - The data constitute two independent random samples, each drawn from a normally distributed population. The population variances are unknown but assumed to be equal.
3. Hypothesis - $H_0: \mu_1 - \mu_2 = 0$, $H_a: \mu_1 - \mu_2 \neq 0$

4. Test Statistic -

$$t = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{S_p^2}{n_1} + \frac{S_p^2}{n_2}}}$$

5. Distribution of Test Statistic. When the null hypothesis is true, the test statistic follows Student's t distribution with $n_1 + n_2 - 2$ degrees of freedom.

6. Decision Rule - Let $\alpha = .05$. The critical values of t are ± 1.645 . Reject H_0 unless $-1.645 < t_{\text{computed}} < 1.645$.

7. Computed Test Statistic - For Internal Wait:

$$S_p^2 = \frac{(712-1)6.66^2 + (487-1)6.73^2}{712+487-2}$$

$$= 44.74$$

$$t = \frac{(12.9 - 12.1) - 0}{\sqrt{\frac{44.74}{712} + \frac{44.74}{487}}}$$

$$t = 5.3333$$

8. Statistical Decision - Reject the H_0 since 5.3333 is greater than 1.645.

9. Conclusion - Conclude that, on the basis of these data, there is an indication that the means are not equal.

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